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## VIEWS, NEWS AND INTERVIEWS.

A new steel cantilever bridge is to be built across the gorge at Niagara Falls, just below the cataract. It will be owned by a syndicate of New York capitalists. In form it will be a combination of the arch and cantilever principles with a span of 1,000 feet, or 200 feet longer than any arched bridge in existence. It will have accommodation for trolley cars, railroad cars and foot passengers.

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It is one of the advantages of the profession of electrical engineering, says London *Lighting*, that the great variety in the applications of electricity compels the electrical engineer to make himself acquainted with the details of all sorts of machinery, and with most of the sciences. To design meters he must be something of a watchmaker; he must understand steam engines, gas engines and turbines; he must be a physicist, a chemist and a mathematician, and must hold himself in readiness to master at a moment's notice the details of any trade and manufacture to which his versatile science may be applicable. Added to this, since the profession is so largely in the hands of young men, he very often is an athlete, a cyclist, or an oarsman.

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When Manager John Stetson and his wife came on from Boston to witness the first performance of "Utopia Limited," says the New York *Evening Sun*, somebody at the Broadway asked Stetson his opinion of a well-known actor.

"Don't like him," growled Stetson. "He's a white-livered chap."

"Oh, don't talk like that, John," interrupted Mrs. Stetson, gravely. "It sounds so vulgar. If you must say that of him put it politely. Say he's got incandescent lights."

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The shore end of the Commercial Cable Company's third cable was successfully laid at Waterville, Ireland, on the afternoon of April 18.

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The committee in charge of the celebration of the closing of the nineteenth and the commencement of the twentieth century of the Christian era, which is to be held in the Holy Land on Christmas Eve, 1899, proposes to have the Columbian Liberty and Peace Bell taken to the Holy

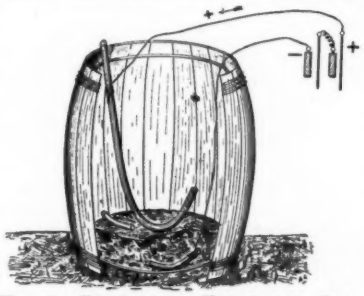

Fig. 1.—Effects of Electrical Currents. Mr. Farnham's Barrel Experiment.

Land for the occasion. It is the intention to toll the bell at the laying of the corner stone of the great temple that is to be erected, and by electrical connection with all the cities of the world to have the bell's peal echoed in every land, thus enabling all the Christian peoples of the earth to participate in the celebration.

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The king of the Belgians got hurt the other day while riding a bicycle.

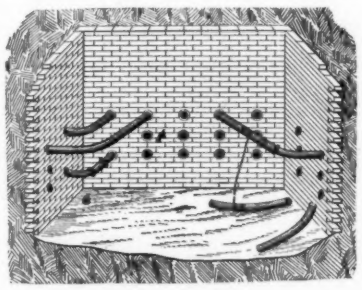

Fig. 3.—Experiment in Subway Manhole.

He is now having constructed a tricycle to be operated by electricity.

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Dr. A. Ebeling has called attention to the danger of nickel-plating delicate electro-magnetic instruments. He observed a case where a deflection of eight degrees could be produced by rotating the case of an instrument parallel to the needle which was magnetized. He finds that plating, even when so thin as to be quite transparent, has a very marked magnetic effect.

## Suing for the Value of Telegraph Stock.

The trial of the suit of John Anderson against John W. Mackay for the recovery of $100,000 damages for breach of contract was commenced in the United States Circuit Court, before Judge Shipman, last week. Anderson alleges that in 1885 he entered into an agreement with E. S. Stokes to act as a manager of the Commercial Telegraph Company, and that Stokes agreed to give him one-quarter of the capital stock of the company. He gave up his business

Fig. 2.—Pitted Cables.

of $20,000 on the Produce Exchange. Subsequent to entering into the agreement with Stokes, Anderson learned that John W. Mackay was in reality the owner of a majority of the company, and was backing Stokes. He claims to have told Mackay of his contract with Stokes, and Mackay, he says, told him to go ahead, that it was all right. On assuming control of the company, Anderson said he found the business in very bad shape. Eventually the company was absorbed

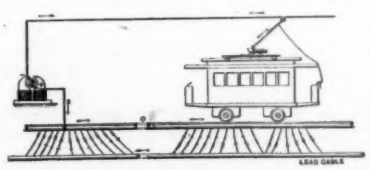



Fig. 4.—Railway Operating with Negative Pole of Dynamo to Trolley.

by another company and Anderson lost his position and all hope of obtaining the stock which had been promised him.

## DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.

ABSTRACT OF A PAPER READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, APRIL 18, 1894, BY ISAIAH H. FARNHAM.

Early in the Summer of 1891 some lead-covered telephone cable removed from wooden ducts in Boston showed some very marked yet local spots of corrosion. The cause of the corrosion was generally attributed to acetic acid contained in the wooden conduit which had years before caused corrosion on a few cables in certain sections of the city. In the case just mentioned, the corrosion was so severe, and located in spots only, that it led me to attribute the cause to electrolytic action from the railway currents, and a letter was written to my company to that effect.

A few months later the lead covering of a cable (No. 208) resting upon the ground in manhole chamber No. 76, located at the corner of Berkeley and Newbury streets, was found eaten entirely through at the point of contact with the earth. I then felt certain the cable had been destroyed by the action of the current. With Mr. W. I. Towne, my assistant, I proceeded to prove the theory.

We took measurements between the cable and the earth, the cable having been repaired and raised from the ground, and found 1.5 to two volts difference of potential, the cable being positive to the earth. A barrel of earth was procured from an excavation in the street, a metal plate placed beneath the earth in the barrel, and two short pieces of lead cable placed side by side on top of the earth. The plate in the bottom of the barrel was then connected to the negative side of a storage battery giving four volts potential, and one piece of the cable lying on the earth was connected with the positive pole of the storage battery. The second piece of cable in the barrel was left without electrical connections. The earth was then saturated with water and the circuit was closed, allowing the current to pass from battery to cable, to earth,

to plate and to battery for seven consecutive days. The pieces of cable were then removed and the piece which had been connected with the battery was badly pitted, closely resembling the cable which had been destroyed, while the second piece of cable showed no corrosion whatever, proving conclusively that a current such as was found in the manhole was sufficient to cause the damage that had been found, and that the corrosion was not, in the case of the experiment at least, due to any acid or salts in the earth.

Fig. 1 shows the barrel experiment, and Fig. 2 is a photograph of the

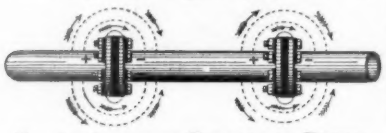


FIG. 5.—ACTION OF CURRENT ON DIFFERENT SECTIONS OF PIPE.

cable No. 208, which has been described as found resting on the earth in the manhole chamber and corroded through; also the pieces experimented upon in the barrel. That shown in the center of the photograph is cable No. 208.

In addition to the experiment just mentioned, we placed in the bottom of manhole chamber No. 76, two short pieces of cable, one of which we connected by a wire to cable No. 208, which had been damaged by electrolysis. (It should be understood that the damaged cable had been repaired and removed from the bottom of the chamber.) Fig. 3 shows the arrangement of this experiment. At the end of six weeks the pieces of cable were removed and examined. The one which had been connected with cable No. 208 was deeply pitted,* while the other piece was free from corrosion.

These experiments, with several others of minor importance, satisfied all who were interested, that electrolytic action was destroying cables, and probably gas and water pipes.

It next became necessary to prove to the electrician of the railway company, that the current causing electrolysis was from the railway system, and not from a leak in the Edison or some other electric lighting system.

Measurements were made between the cables in all manholes and the earth near the cables, for voltage and direction of current. It was found that within a radius of about 2,000 feet from the Albany street power house, cables were negative to the earth, ranging from zero to two volts, and that outside of this neutral line, they were positive to the earth from zero to 12 volts. This condition prevailed until a point was reached near the East Cambridge power house, when they again passed a neutral line and became more and more positive as that power house was approached. The same conditions were found as the Allston railway power house was approached. On obtaining sufficient data, maps were drawn, showing voltage between cables and earth throughout all sections of the city.

These potential measurements, though taken for other purposes, incidentally furnished all the proof needed to convince one that the railway power was the source of the troublesome currents. At the time the map was made, and previously, the railway was operating with the negative pole of the dynamo to the trolley, the positive side being to the rails.

Fig. 4 is intended to illustrate this condition. It shows the passage of current from the dynamo to the rails, and the passage of a portion of the current from the rails to the cables within the neutral or zero line, and from cables to rails outside of this zero line. The danger of electrolysis is only where the current is leaving the cable or pipe through the moist earth, hence the dangerous district was at this time outside of the zero or neutral line, as shown in this Fig. 4.

Having outlined our early experience in running down this new trouble, we will next mention some of the proposed and applied remedies. Several conferences were held for the purpose of suggesting and discussing means for preventing the destruction of the cables, at which the officers and experts of both the railway and telephone companies were present, and it should be said that the railway company in Boston has shown a disposition to adopt any promising plan for overcoming the evil, save, perhaps, the abandonment of the rails and earth as a part of the circuit.

First. It was proposed to remove all cables from the wet bottom and sides of the so-called manholes. It was found very difficult to place and retain cables free from the wet sides, and even could this have been accomplished, the action at the mouth of the ducts, and within them, would still have continued. They were, however, all removed from the bottom of the manholes.

Second. It was suggested that the

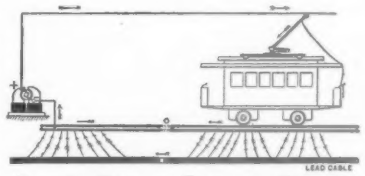



FIG. 6.—TYPICAL FLOW OF CURRENT FROM TROLLEY TO CABLES.

cables might be connected to ground plates in the manholes, and so transfer the electrolytic action to these plates, and thus save the cables. This experiment was tried on an extended scale, but though many ground plates having a surface of several square feet each were connected with the cables over a large portion of the city, it was found that voltmeter readings taken between the cables and a point on the earth a short distance removed from the ground plate in any manhole, gave nearly the same pressure as before the ground plates were connected.

In some cases the voltage between the cables and the earth was reduced 25 per cent; in many others no noticeable reduction was made. The ground plates were constructed from pieces of old lead cable, six to 10 feet in length and embedded in the wet earth at the bottom of the manholes. It was evident from this test that ordinary ground plates would not prove of material advantage for protecting the cables.

Third. Prof. Elihu Thomson suggested, among other possible remedies, the placing of motor generators at different points along the railway line, wherever the cables and pipes are found to be in danger, the motor generators to be operated by the railway power current; the secondary current developed by these generators to be utilized to lower the potential in the cables and pipes to zero, with respect to the surrounding earth or rails. The suggestion included means for automatically starting and stopping the generators, as cables might become positive or negative to the rails. The motor generators would, so to speak, pump the current out of the cables and force it into the rails whenever the potential of the former should rise above zero. This plan has not yet been put into operation so far as I am aware.

Fourth. Insulating the cables and pipes from the earth was proposed. As some of the worst cases of corrosion of cables by electrolysis occurred where they were painted with asphalt, taped, painted again, and finally covered again with a heavy braiding also saturated with asphalt, it was apparent that to insulate cables sufficiently to protect them would be difficult and expensive, if indeed practically possible. To protect water and gas pipes by a sufficient insulating jacket was seen at once to be impracticable.

Fifth. Breaking the metallic continuity of the cable sheath and pipes was proposed. From the fact that severe action is frequently found in comparatively isolated spots, where cables and pipes cross each other or pass near and across the rails, it follows that any system of breaking the metallic continuity would have to be studied with reference to the entire complicated system of pipes, cables and rails ramifying through the streets of a city. There would also be a difference of potential between the several sections of cable or pipe, severed metallically, tending to cause electrolysis at one end of each section, as illustrated in Fig. 5. In case of water pipes, treated in this manner, the action might be expected on the interior as well as on the exterior. There appears to be some evidence of such an action as this in gas and water pipes where the electrical continuity is partially broken by leaded joints.

Sixth. My assistant, Mr. Towne, suggested that the railway current might be so frequently alternated as possibly to prevent serious action on the pipes and cables. The theory was, that before the oxygen gas, liberated by the current, should have time to attack the metal, the reversal of the current would disperse it. A careful experiment was conducted, extending over a period of 10 days, employing a pressure of current of from three to seven volts, and alternating its direction at regular periods of one minute by specially devised apparatus. No material change had taken place in either plate during this period of time. We then considered the practicability of reversing the railway current fre-

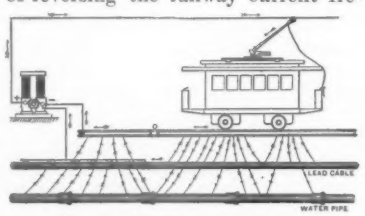



FIG. 7.—MR. PEARSON'S PLAN.

quently. It seemed possible to reverse it once each 24 hours at a given time in the night when the load is comparatively light. To do this in a large system involving several power stations, would require either a loss of current for a few minutes in order to guard against one station reversing before some other had opened or reversed its current, or would require some electrical system connecting the several stations together and operating the reversing apparatus simultaneously. We concluded it would be very difficult, if, indeed, at all practicable, to reverse such heavy currents during regular traffic. We then renewed the reversing experiment, giving 24 hour periods between each alternation, but found at the end of two weeks, to our sorrow, that the plates subjected to the action of the current were seriously electrolyzed. It seemed useless to pursue this line of work further at that time. When alternating current motors become practicable for use on street cars, advantage may be taken of the fact that such currents appear not to cause electrolysis to the extent of injuring pipes and cables exposed to them.

Seventh. At about this stage in the study of the problem, Mr. Frederick S. Pearson, then engineer of the West End Street Railway Company, made two suggestions which, though separate in themselves, and presented at different dates, yet carried out in conjunction, have proved exceedingly helpful in overcoming the difficulty, at least so far as relates to telephone cables. It occurred to Mr. Pearson first, that if the railway current should be reversed so that the positive pole would be connected with the trolley, the danger of electrolysis would be removed from the greater and more scattered portion of the city, and be brought near the power stations where it possibly could be more easily dealt with. This reversal was made and the expected potential changes between cables and earth followed. It was also noted that the cables near the power house, which had been from one to two volts negative to earth before the change of current, were now one to nine volts positive to earth; that is, they were raised higher above zero than they had been below zero prior to the reversal. Fig. 6 is a typical representation of the current flowing through trolley, car, rails and cables at this time. It will be readily understood that with the conditions as illustrated in this figure, the electrolytic action would be confined to the territory comparatively near the power stations where the current is leaving the cables to reach the negative or rail side of the dynamo.

Mr. Pearson next suggested the plan of running out large copper conductors from the negative side of the dynamo and extending them through the dangerous district, connecting them at frequent intervals to the cables. Fig. 7 diagrammatically illustrates this plan. On the principle involved in Professor Thomson's motor generators, this low resistance conductor, connected directly to the dynamo, was to pump the current from the cables and so prevent its passage into or through the moist earth. Some of us were skeptical as to the completeness of this proposed remedy. It seemed possible that even with such a good return conductor, some of the current might still pass into and through the earth. Voltage measurements, however, at once dispelled the doubts, for we found that the cables measuring nine volts positive to earth, gave a reading of 22 positive to the return conductor; that is, the return wire, as relating to the cables, was at all points more negative than the earth (if we may be allowed the expression). The return conductors were made up of a large number of No. 18 copper wires formed into cables about one inch in diameter, known as conductors of 500,000 circular mils. These conductors were extended in each direction from Albany street power house entirely through this dangerous district, its longest section being about 4,300 feet.

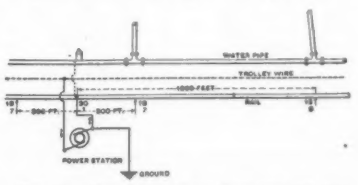



FIG. 8.—CONDITIONS AT ALBANY, N. Y.

The cables in every manhole within the district were connected by several No. 12 copper wires to the return conductor and soldered. On first connecting the cables to the return conductor, which took place December 24, 1892, the current was sufficient to melt several strands of No. 12 wire. A measurement for current flowing in the main return conductor, which was used for relieving the cables only, gave about 500 amperes.

* The plumbers of Omaha, Neb., apply the name of "small-pox pipe" to that pitted by electrolysis.

It may be interesting here to note comparative voltages in the district near the power house, as given in the accompanying table:

| Manhole No. | First Measurement to earth. | After Reversal of Railway Current. | Between cable and Return Conductor. | Between Cables and Earth after Return Conductor was connected to Cables. |
|---|---|---|---|---|
| 155 | 1.5 + | 0.2 − | 32 + | 4.5 − |
| 154 | 1.5 + | 0. + | 32 + | 4.5 − |
| 153 | 0.5 + | 0.1 + | 33 + | |
| 152 | 0.5 + | 2.6 − | 33 + | 0.8 − |
| 151 | | 4.8 + | 33 + | |
| 150 | 0.7 − | 5. + | 33 + | 0. − |
| 149 | 0.7 − | 5.8 + | 33 + | 1.4 − |
| 148 | | 6. + | 33 + | |
| 147 | | 6.5 + | 33 + | |
| 146 | 0. − | 6.5 + | 33 + | 1.5 − |
| 145 | | 6.5 + | 33 + | 0.5 − |
| 144 | | 7. + | 33 + | 1.8 − |
| 143 | 0.5 + | 7.1 + | 33 + | 0. − |
| 142 | 0.5 + | 7.1 + | 33 + | |
| 141 | 0. + | 7.6 + | 33 + | 0. − |
| 140 | | 7.6 + | 33 + | 7.1 − |
| 139 | 0.2 + | 8.2 − | 33 + | 7.1 − |
| 138 | 0.5 + | 8.5 + | 33 + | 7.1 − |
| 137 | 0.5 + | 8.5 + | 33 + | 3.6 − |
| 136 | 0.5 + | 8.5 + | 33 + | |
| 135 | | 8.5 + | 33 + | 0. − |
| 134 | 0. − | 8.5 + | 33 + | |
| 133 | 0. − | 8.5 + | 33 + | 0.1 − |
| 132 | 0. − | 8.5 + | 33 + | 0.5 − |

The cables on the Boston side of the draw of West Boston bridge, proved to be positive to both the rail and the water, while on the other side of the narrow draw the opposite condition existed, showing at once that it was unsafe to assume any neutral lines or potential difference, without making measurements to determine the absolute facts.

So far this paper has dealt particularly with the subject of protection of lead-covered cables. It might be inferred that water and gas pipes can be treated in precisely the same manner with the same results, or as water pipes have a much greater sectional area of metal, it might be presumed that simply a connection of such pipes to the dynamo at the power station would be sufficient to bring their potential down to zero throughout the dangerous district. The facts so far coming to our notice would materially modify such inferences, and therefore should find a place here.

That iron pipes are as truly subjected to the corrosion as lead, need not be stated to the members of this society, but for the benefit of city officials and others who may read the paper, it should be plainly stated that they are quite as readily destroyed by electrolysis.

The city engineer of Milwaukee, Mr. G. H. Benzenberg, has kindly sent me a photograph of a six-inch iron water main, badly corroded. It is the best specimen of cast-iron pipe I have been able to obtain, although not the most serious case of corrosion.

Mr. Benzenberg writes that the trouble in that city was chiefly noticed upon the six-inch water main extending 100 feet on each side of a point opposite the railway power station. Services entering this main were also destroyed, and all were renewed three times during the past two years. He states further, and I quote his own words, "at other points where power houses were established thereafter, the mains were immediately connected by extra heavy copper wires with the generator; we have had no trouble with them so far."

Mr. O. H. Tripp, engineer at Rockland, Me., recently furnished me with a specimen of wrought-iron pipe destroyed in five months; the fact is of special interest, as it comes from a city having but a small railway system.

In Boston, there have been water as well as gas service pipes corroded through by electrolysis. I have not learned of any mains having burst from this cause. Measurements of water pipes in the city indicate they are still in danger, notwithstanding several thoroughly made connections with the pipes at the power station; the same is true in Cambridge, Mass. This leads me to call attention to an interesting series of inquiries.

The engineer of the Water Board at Rochester, N. Y., suggested to me, a short time ago, while looking into the question of electrolytic action upon the pipes in that city, that possibly there might be sufficient resistance in the joints of the water mains to cause an action upon the lead ring which forms the connection between sections of pipe. He stated that not unfrequently there is found a film of moisture between the pipe and this lead ring, and as the pipes are coated with a preparation of tar or asphalt on both the inner and outer surfaces before they are laid, there might be a poor electrical connection. Without having made any inquiries or tests upon this point, it seems to me probable that the careful calking which is given in these lead rings, would form in some portion of each joint a good electrical connection; that is one of very low resistance. Recent measurements, however, made in Boston, and others made in Albany, during the latter part of March, this year, convince me that their is a very appreciable resistance in such joints.

Fig. 8 will illustrate the conditions at Albany. We found the negative side of the dynamo to be connected with the rails, and with ground plates in old wells; no connection had been made with water or other pipes. Directly in front of the power station the voltmeter indicated a pressure of 20 volts between water pipe (an 8 inch cast-iron pipe) and the rail, the pipe being positive. A reading taken about 300 feet in either direction, up or down the street, indicated about 18 volts. At a point 1,200 feet north, the reading was lowered to 12 volts. We then connected the rail side of the dynamo to the street hydrant and took new readings, finding one volt at the station, seven volts at 300 feet distant, the same south, and eight volts at a point 1,200 feet north.

These measurements, with similar indications in Boston, show plainly that there is a very appreciable resistance in the water-main joints. At the same time the measurements give fair evidence that the difference of voltage between any two sections of water pipe is very small. The interested parties at Albany have kindly consented to allow any facts or figures obtained there in reference to this subject to be placed in this paper.

A few measurements made through the danger district will be of interest. The station is situated near the southern extremity of the city. The danger district extends north about one mile, and over this portion of the district the following figures were obtained. They were taken at nearly uniform distances of about 500 feet, beginning at the station.

MEASUREMENTS IN THE DANGER DISTRICT.

| | | | | | |
|---|---|---|---|---|---|
| At Station, | Cable | to | Earth, | Pos., | 12 volts. |
| " | " | " | Rail, | " | 25 " |
| " | Water | " | " | " | 20 " |
| 500 Ft. N., | Cable | " | Earth, | " | 10 " |
| " | " | " | Track, | " | 22 " |
| " | Water | " | " | " | 12 " |
| 1,000 | Cable | " | Earth, | " | 6 " |
| " | " | " | Track, | " | 18 " |
| " | Water | " | " | " | 12 " |
| 1,500 | Cable | " | Earth, | " | 6 " |
| " | " | " | Rail, | " | 18 " |
| " | Water | " | " | " | 18 " |
| 2,000 | Cable | " | Earth, | " | 8 " |
| " | " | " | Rail, | " | 16 " |
| 2,500 | " | " | Earth, | " | 6 " |
| " | " | " | Rail, | " | 13 " |
| " | Water | " | " | " | 8 " |
| 3,000 | Cable | " | Earth, | " | 4 " |
| " | " | " | Rail, | " | 11 " |
| 3,500 | " | " | Earth, | " | 3 " |
| " | " | " | Rail, | " | 12 " |
| " | Water | " | " | " | 7 " |
| 4,000 | Cable | " | Earth, | " | 3 " |
| " | " | " | Rail, | " | 8 " |
| 4,500 | " | " | Earth, | " | 1 " |
| " | " | " | Rail, | " | 1 " |
| " | Water | " | " | Neg., | 1 " |
| 5,000 | Cable | " | Earth, | Pos., | ½ " |
| " | " | " | Rail, | " | ½ " |

It is proposed at Albany to extend large wires (0000) through the dangerous district, one wire for each system of pipes, connecting the pipes to them at frequent intervals.

It is probable that the remedy which has been applied to telegraph cables in some cities, has been the more positive from the very failure so far to thoroughly protect the other systems of pipes against electrolytic action. Fig. 7 (already shown) may assist to a clear understanding of this. The cables are here shown connected by a large wire to the dynamo, while water pipes are not so treated. Therefore, the current which enters the water pipes at points outside the danger district passes to the neighborhood of the power station, and, in leaving them there, raises the potential of the earth about the cables. In other words, the current flows from the water pipes to the ground and thence to the cables in order to reach the dynamo.

Connecting any one system of pipes to the dynamo will, in a measure, protect other systems of pipes, but connecting all systems reduces the certainty or margin of certainty of protection to any one system. This will be apparent from a little study of Fig. 7 just referred to.

When all cables and pipes in the danger district are connected by sufficiently large conductors to drain them, a careful adjustment in resistances in these several conductors may be found necessary in order to insure a balance between the several systems of pipes. It may lead to the necessity of reducing the carrying capacity of

MANHATTAN ELECTRICAL SUPPLY COMPANY'S TELEPHONE SET.

the conductor returning to the dynamo from the rails themselves.

The question has already arisen, and it doubtless will be repeated here: "How small a difference of potential between pipe and earth will cause electrolytic action?" In reply to this, it may be stated that some of the worst cases of corrosion in Boston have occurred where the difference was but one and one-half volts. Mr. A. T. Wells, of Chicago, in describing to me an examination of some of the first cases in Cincinnati, states that the "difference of potential between the cables and the rail was never more than one-half, and usually less than one-quarter volt." Such a difference between cable and rail would mean a much less difference between cable and earth, where electrolysis takes place. Mr. John C. Lee, of Boston, has experimentally caused the corrosion on lead and iron by a difference of potential of $\frac{1}{10}$ volt.

These facts certainly indicate that but a very small pressure is necessary to produce the action and should dispel the numerous statements that well bonded rails or a large amount of rail return wires will alone overcome the trouble. In some cities, where electrolysis is in progress to-day, the return copper nearly equals that of the trolley and feed wire system. We cannot force the current to take one path exclusively when others are open to it.

The facts given above, with others similar, though not enumerated, lead me to these conclusions:

First. All single trolley railways employing the rails as a portion of the circuit cause electrolytic action and consequent corrosion of pipes in their immediate vicinity, unless special provision is made to prevent it.

Second. A fraction of a volt difference of potential between pipes and the damp earth surrounding them is sufficient to induce the action.

Third. Bonding of rails, or providing a metallic return conductor equal in sectional area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.

Fourth. Insulating pipes sufficiently to prevent the trouble is impracticable.

Fifth. Breaking the metallic continuity of pipes at sufficiently frequent intervals is impracticable.

Sixth. It is advisable to connect the positive pole of the dynamo to the trolley lines.

Seventh. A large conductor extending from the grounded side of the dynamo, entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usually ensure their protection.

Eighth. It is better to use a separate conductor for each set of pipes to be protected.

Ninth. Connection only at the power station, to water or gas pipes, will not ensure their safety.

Tenth. Connection between the pipes and rail, or rail return wires, outside of the danger district, should be carefully avoided.

Eleventh. Frequent voltage measurements between pipes and earth should be obtained, and such changes in return conductors made, as the measurements indicate.

### The Manhattan Electrical Supply Company's Telephone Outfit.

The Manhattan Electrical Supply Company, 36 Cortlandt street, New York city, have placed on the market a number of moderate priced telephone outfits, one of which is illustrated herewith. The instruments will work on lines over 100 miles long under favorable circumstances, but they are not recommended for use on such long lines, as they give better satisfaction on lines under 10 miles in length. The transmitter has a mouthpiece mounted on the door of the case. The magneto call bell is the regular "pony" made by the Manhattan Electrical Supply Company, and will work on lines up to 10 miles long.

### An International Electrical Exhibition at Paris.

Arrangements are in hand for holding an international electrical exhibition in Paris in 1895. The exhibition which is to be opened on July 1 until October 31 of that year will be divided into two parts. The generating plant will be in the Palais des Machinés, at the Champs de Mars, while the various kinds of electrical plant accessories will be shown in operation in the Palais de l'Industrie at the Champs-Elyseés. An electric railroad will connect the two sections.

The Tampa, Fla., Street Railway and Power Company's plant is soon to be sold by the receiver.

## ON THE DEPOSITION OF CARBON IN INCANDESCENT LAMPS.

BY E. A. COLBY.

During the discussion of Professor William A. Anthony's paper on the "Effect of Heavy Gases in the Chamber of an Incandescent Lamp," recently read before the American Institute of Electrical Engineers and published in the ELECTRICAL REVIEW, Mr. E. A. Colby, of Newark, N. J., made some very interesting remarks which are given in abstract herewith:

I found some 11 years ago when making some lamps of 125 candle-power—which were lamps of relatively high potential—125 volts, that there were serious troubles in the construction of such lamps due to short-circuiting, and the only way in which we could overcome that difficulty was either to not exhaust the lamp to the same extent that we ordinarily did a low candle-power lamp, or else having exhausted the air, to leave within the

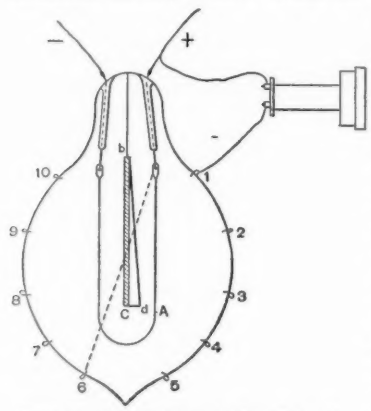


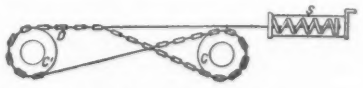

DIAGRAM ILLUSTRATING MR. COLBY'S EXPERIMENT.

lamp bulb some inert gas. This was in Mr. Weston's laboratory in Newark, N. J. We tried at that time a great many different gases, among others bromine and several of the chlorine compounds. We finally concluded, as a result of a long series of experiments, that the most suitable vapor to use in this connection was that of chloroform. Chloroform being somewhat rich in carbon, would, of course, upon entering the bulb (the filament being at the temperature of incandescence), be decomposed, and carbon would be deposited on the filament, while the nascent chlorine would combine with any mercurial vapor which might be present in the bulb. As a matter of fact, we had within that bulb quite a heavy deposit, white in color, and resembling in all its physical characteristics, mercuric chloride. In fact, the deposit was so heavy, that the filament itself was at times concealed from view very much as it is in an opalescent globe. To remove this deposit we applied a Bunsen burner in the ordinary way, and immediately the deposit was vaporized and the bulb was left clear. But the important point in this connection was this, that the difficulties which we had experienced previous to this treatment, viz., short-circuiting, had entirely disappeared, and whatever blackening we had been troubled with was diminished. It was a matter of some experiment to determine what proportion of vapor it was expedient to leave within the bulb, and one simple method which I adopted at that time suggested certain lines of research which I have been unable to follow, and which I would like to mention in the hope that some who are still in the incandescent lamp field can take it up. I have felt certain that there were two causes, as we all know, for the diminution in the candle-power of the lamp. The first was the vaporization of the carbon, and its subsequent deposition upon the bulb, reducing the transparency of the same, and the second was the change in the condition of the carbon filament itself. The vaporization, of course, is a function of the temperature to which the filament is subjected, and is to a very much less extent dependent upon the difference of potential between the terminals. However, working at higher potentials this difficulty increased. The other defect was due, as I said a moment ago, to the change in the structure of the carbon itself. Apparently a deposit of carbon was formed upon one leg of the filament, which carbon was separated from the opposite leg. I was interested in ascertaining whether I could prevent this deposit, and so maintain the normal appearance of the filament by the interposition of a shield between the two legs of the carbon. I supported a glass plate between the two legs of the carbon filament, and suspended the lamp vertically, the loop hanging down, and noted the deposition of carbon upon this shield between the two legs of the filament. That, of course, would be naturally expected. But a curious feature of it was this, that the deposit was chiefly on one side, and that the depth of deposit over this glass shield increased from the top of the shield down towards the bottom, that is, the loop of the lamp being in this form (A Fig. 1) and the shield being down here (*b c*), the depth of the deposit was heaviest at the bottom instead of heaviest at the top where the greatest difference of potential existed. Fig. 1 represents the general outline of the lamp. It was known at that time as the Mogul lamp. A number of them were placed in the Equitable Building, 120 Broadway, in 1883 and 1884, and attracted considerable attention at that time on account of the large candle-power of the lamps. They were made up to 600 candle-power. The difficulty we had in the first construction of these lamps, was due to a discharge directly across from stub to stub. I then put here a glass plate (*b c*), which was supported on a neutral wire at that point to increase the distance between the terminals and prevent any direct path between the two. The deposit that was formed upon that plate I will illustrate by a line like that (*b d* Fig. 1), showing increase in thickness at the lower edge of the glass plate. Both legs of this filament under these conditions with the interposed shield, remained perfectly clear and as brilliant as they were in the original lamp, although with increase of temperature the deposit of carbon on the bulb was materially increased. I then sealed into another bulb, without the glass shield, a series of platinum wires going all around it, in the plane of the enclosed carbon, just little hooks, the wires passing through the bulb. I connected a telephone to the terminal which we will say was the positive pole. I connected the other terminal to loop No. 1, and with the lamp working at its normal candle-power, after I had obtained a certain degree of exhaustion, I succeeded in getting a musical note in the telephone. By then transferring the conductor to loop No. 2 I got a note of a slightly higher pitch, and upon transferring the connection to each succeeding loop the pitch of the note correspondingly increased until I reached a point which was nearly diagonally opposite the stub + or in the line + 6, which would be the diagonal of the area enclosed by the loop, when I got the maximum note from the telephone.

As I passed along up here (7–10) the note diminished in pitch until I got up here (10) when it was inaudible entirely. By connecting the telephone to the negative terminal and the sealed-in wires, I got no sound whatever. It was always a mystery to me and it is not yet solved, for the reason that I have been out of the incandescent lamp business for several years, and I would like to know whether anyone else can explain the matter. As I understood Professor Anthony in his paper, he stated that the action which produced the blackening was not purely electrical, but was in all probability simply the volatilization of the carbon alone at high temperatures. If a telephone was inserted between any two of these loops, I got no musical note whatever, indicating that there was no electrical action between those two points—no difference of potential sufficient to give a telephonic current. A peculiar feature about this experiment was this: that the lamp was on a direct current circuit, and the pulsation which would give that musical note must have been in all probability due to inequalities in the current of the dynamo. I used this dummy lamp as a means of indicating when I had secured the proper degree of rarefaction in the other lamps from the same pump. That is, this lamp was attached to the same fork by which other lamps were being exhausted, and the exhaustion was continued until I got a slight note in the telephone, when I discontinued the exhaustion. These lamps, as they went out, had a residual atmosphere of chlorine gas, and possibly some little undecomposed chloroform which was subsequently decomposed in use. I made another preliminary experiment with a different construction, which was known as the U tube lamp. I believe it was subsequently patented by Mr. Stanley. In it I had a U loop of the same shape as shown in Fig. 1. The object of this construction was to protect each leg of the carbon filament from any direct electric action across from the other leg. This lamp was raised to a very high temperature without the filament changing its appearance, although the blackening of the bulb was very pronounced. I think anyone who has had very much practical experience in the manufacture of lamps will be surprised to learn that carbon does not cast a shadow at all. It certainly was a very common thing in my experience to see lamps exhibiting this characteristic. I have succeeded in obtaining it with various lamps, and with platinum, iron and copper filaments, and I know no reason why, if the conditions are made proper, it may not be produced with all lamps. Of course, if the carbon is raised to a comparatively low temperature, and not subjected to sudden changes, the volatilization will be very uniform and the shadow of the filaments will hardly be perceptible. Whereas, if there are irregular or weak points in the filament or it is subjected to sudden changes in potential, then the shadows become quite marked.

## An Ingenious Car Starting Apparatus.

There has been working for a considerable time, and with most satisfactory results, on one of the London, Deptford and Greenwich Tramway Company's cars, Messrs. Vereker and Yeatts' car starting apparatus, in which the energy of a car while being stopped is stored up by a spring, put into tension by the winding up of a chain on a drum, mounted on the axle of the vehicle. The spring is retained in tension by a clutch mechanism until released by the first pull of the horses, when it moves the car forward. The principle is not new; but the details have been carefully worked out, and the result is satisfactory. Referring to the illustration, which is from London *Engineering*, the only fixture to the car is the spring S, which is in this case a helix, about five feet long. The spring operates through a rod which connects with a chain D passing over and around the drum $C^1$ on one axle, thence over and around the drum C on the other axle, the end being also attached to the rod. The drums have fixed teeth on the face, and engage into a clutch having teeth, which yield when the drum is revolving in the reverse way, without making any noise. The shanks of these movable teeth or pawls are recessed in a rounded hollow portion so that no bolt is required, and behind them is a spring which holds them up to their work when in gear. When not in gear the pawl is held in position by a step abutting against the end of a bolt, which counteracts the load of the spring behind the pawl. The drums ordinarily run loose on the axle, and when the car is about to stop, an arrangement of levers enables the driver by a foot spud to throw the drums in gear, and they are thus caused to rotate with the axles, so that the endless chain tightens and loads the spring. The connecting chain winds round the wheels in opposite directions, so that the tightening of the spring is done by the drum on the leading axle, while the other drum runs loose by reason of the formation of the pawl on the clutch. As the drum cannot slip back by reason of the pawls, the arrangement acts as an emergency brake, and so long as both clutches are kept in gear this brake continues effective. It is therefore necessary that the clutch of one drum should be thrown out of gear before the car starts. The system of




CAR STARTING DEVICE.

levers has connection with the drawbar of the car, so that the horses pull the lever forward, disengaging the clutch on the axle of the leading wheels, whereupon the spring in tension draws forward the chain gear and revolves the axle and hind wheels. The car is thus started, so that there is no strain on the horses, nor in the case of mechanical motors is there the same maximum load, which has been shown to be 10 times the ordinary traction load. The efficiency of the apparatus was recently demonstrated to a number of engineers. It is simple, does not involve material alterations in the car, and is entirely under the car. The levers can be worked from either platform, the foot spud being movable, so that on the passenger platform there is no obstruction.

## SELF-WINDING CLOCKS.

INTERESTING APPARATUS FOR FURNISHING EXACT TIME.

The Self-Winding Clock Company, 26 Broadway, New York, are the manufacturers of the self-winding clocks illustrated herewith and which are rapidly coming into general use. The motive power for this clock is derived from the action of a fine spring, as in the ordinary mechanical clock.

The term self-winding results from the following: Two small cells of battery are placed in the top of the case and connected with a motor secured to the lower part of the movement.

FIG. 1.—SELF-WINDING CLOCK COMPANY'S SELF-WINDING CLOCK.

As the center wheel, driven by the unwinding of the spring, makes one revolution around the hub, it brings up a loose arm which slips under a stationary projecting arm fastened to the train plate. The moment this contact takes place, the circuit is closed, and the action of the little motor rotates the barrel containing the spring one revolution from left to right, winding up just as much of the spring as has been required to run the clock during the last 60 minutes.

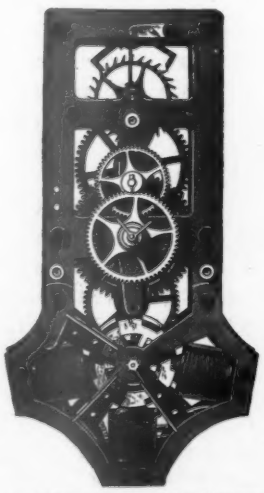


FIG. 2.—MOVEMENT OF SELF-WINDING CLOCK.

The spring barrel itself carries an arm which slides the loose arm from under the projecting arm, breaking the circuit; the same action is repeated every 60 minutes. It will easily be seen by those familiar with mechanism, how simple and practical is this device. Some advantages claimed for this system are as follows:

First. These clocks are entirely automatic, self-winding at regular intervals, by electricity, thus obviating all the care and attention required in the use of key-winding clocks.

Second. This principle of frequent and regular winding not only shortens the train, but decreases the friction and strain to the lowest degree.

Third. This system does away with all necessity for use of a maintaining power, as the spring is wound in the same direction the train is moving, thus maintaining a perfect uniformity of tension, which all horologists admit is of the greatest importance, and without which perfect time cannot be had.

Fourth. Clocks so constructed are very superior as accurate time-keepers.

Fifth. Any intelligent person can set these clocks running by simply following the directions given.

Sixth. These clocks are guaranteed to run without attention for over one year.

Seventh. These movements are made of the best material, with steel-cut pinions hardened and polished; the cases are finely finished and all the workmanship connected with the clocks is of the highest order.

While these clocks, by reason of this system of regular and uniform winding, are the most accurate of time-keepers, the company has developed a special system for uniform time service. Each clock is provided with a simple attachment, by means of which the clock hands may be controlled automatically by electricity.

In order to secure an absolute uniformity of time at all stations on any line, it is only necessary to utilize the present wires once each day for no longer period than is required by the present method of sending "time."

During this period the standard clock takes possession of the wire and temporarily controls all clocks connected with it, securing absolutely uniform time throughout the entire system. This is done with certainty and precision, and is the only method whereby uniform time which may be relied upon can be secured. This system embraces the Gardner synchronizing and time signaling patents which are now owned by the Self-Winding Clock Company.

The program clock shown in Fig. 4 is designed for schools, colleges, factories and railroads. It consists of two or more cylinders, with screw holes in them corresponding with each minute of the 24 hours. Connected with a self-winding clock, this instrument is operated by a motor receiving impulse from the clock.

Small plugs which are provided may be screwed into holes representing any desired minute of the day or night. These plugs in connection with the clock, close an electric circuit for ringing signal bells in recitation rooms in conformity with the school program for the day.

Bells may be rung for starting trains according to time table during the day and night, with additional cylinders for Sunday change of time table. The advantage of this system over old methods, where the employment of a large force of assistant train dispatchers is necessary, and a constant supervision required, will be appreciated by all railroad men.

## ELECTRIC LIGHT FLASHES.

Ovid, Mich., is to have an electric lighting plant.

The city of Dallas, Tex., is considering a proposition to build its own electric plant.

At a meeting of the directors of the Edison Electric Illuminating Company, of Boston, a dividend of one and one-half per cent was declared payable May 1 to stockholders of record April 17. Books closed April 17, open May 2.

Those who purchased the plant of the Staten Island, N. Y., Light, Heat and Power Company have decided to name the corporation the Port Richmond Electric Light Company. Articles of corporation have been filed. The officers are: President, Charles H. Ingalls; vice-president, J. Frank Emmons; and secretary and treasurer, Junius B. Alexander.

The city council of Yuma, Arizona, has granted to Col. Geo. A. Allen franchises for an electric light plant, waterworks and telephone line throughout the town. Yuma has electric lights and the finest pumping water plant in the West. West Yuma will now be supplied with water and electric lights. Work will begin at once and crowded to completion.

The certified statement of the Fall River, Mass., Electric Light Company, filed with the State department, is as follows: Last annual meeting, March 12, 1894; certificate filed April 4, 1894; treasurer, Owen Durfee; fixed capital, $200,000. Assets, land, water power and buildings, $30,000; machinery, $86,650; cash and debts receivable, $21,601; miscellaneous, $65,-614; total, $201,866. Liabilities, capital stock, $200,000; debts, $1,626; profit and loss, $239; total, $201,865.

Rondout, N. Y., was in darkness the night of April 14, every electric and gas lamp being turned off. The Common Council at a recent meeting decided that the Kingston Electric Company was not lighting the city according to contract, and notified it to discontinue its service in the streets and public buildings April 12. Thursday and Friday night the company furnished light at its own expense, but stopped after that. Many property holders were uneasy because the lights were turned out in the engine houses.

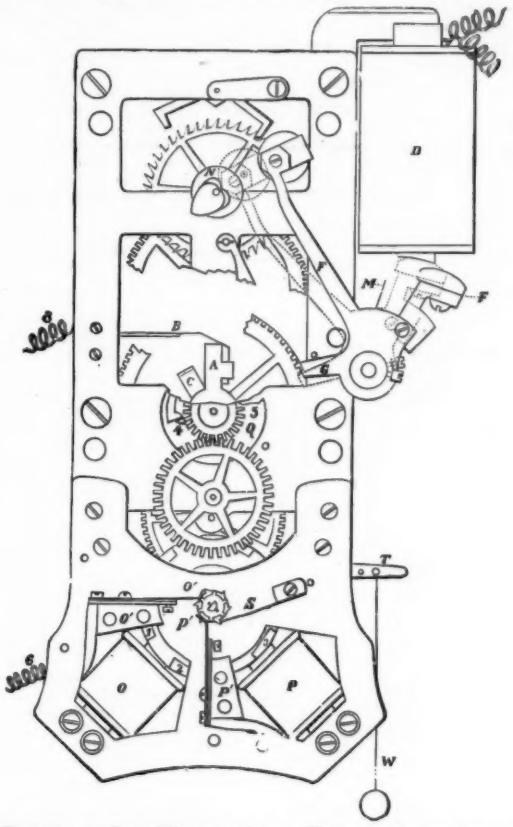


FIG. 3.—DETAILS OF SELF-WINDING CLOCK MOVEMENT WITH SYNCHRONIZER.

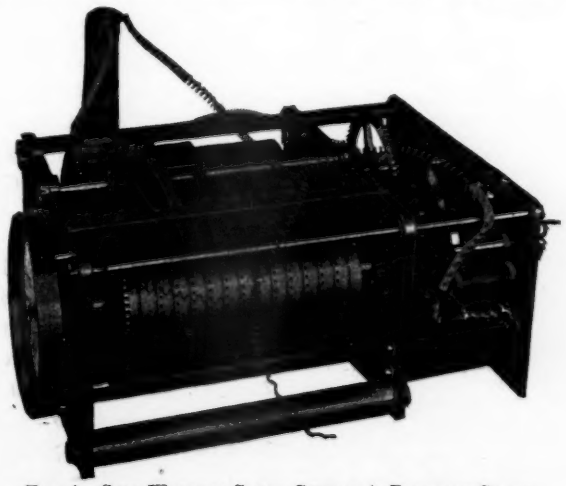


FIG. 4.—SELF-WINDING CLOCK COMPANY'S PROGRAM CLOCK.

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Every practical electric railway man is becoming a constant reader of this journal.

Some new experiments, new ideas and new batteries and motors enter into the work that Messrs. E. H. Johnson and John M. Pendleton and Inventor Lundell are devoting themselves to for traction purposes. Hurry up, gentlemen.

If you have been so badly scared by the hard times of the exceptionable year of 1893 that you haven't dared to venture to increase your business, just start in to-day and see how easy it is to succeed. Have more faith in yourself and your neighbor, and business will improve with you at once. There are a number of enterprising concerns in this field that realize that this is going to be a great electrical construction year, and they seem to have a pretty good idea of the best medium through which to reach their customers. The advertising pages of the ELECTRICAL REVIEW speak for themselves.

How do you like the new and clean face the pages of the ELECTRICAL REVIEW present to you this week?

We predict: There will be more new and substantial construction and installation of electrical and allied interests in this country during 1894 than during any previous year. Allen R. Foote, we would like to have you keep the score.

A running horse called "Volt" won a race at Memphis, Tenn., one day last week. It is not known that his jockey was equipped with electric spurs or an electric whip, but the added energy of the horse's name is supposed to have been the cause of success.

In an editorial entitled "The Institute Elections," published in *Electricity* for April 18, it is emphatically suggested that Mr. George M. Phelps, of the *Electrical Engineer*, should retire from the treasurership of the American Institute of Electrical Engineers "and be succeeded by some one who, by education, by profession and by his daily walks in life, may be presumed to be better qualified to assume the onerous duties of member of council than the incumbent," and much more in the same strain.

The innuendo meant to be conveyed is malicious and wholly untruthful and will deceive none of Mr. Phelps' numerous friends. As a matter of fact, Mr. Phelps is a thoroughly trained electrician, and for many years held the responsible position of superintendent of the large electrical factory of the Western Electric Company. Where could better electrical training be secured? Mr. Phelps is, besides, a patent expert of no ordinary attainments. He has been identified with electrical work from his youth. His father was an able inventor and electrician before him and brought up his son to follow in his footsteps.

In endeavoring to malign Mr. Phelps for alleged inability to properly fill an office in a scientific and non-commercial body like the American Institute of Electrical Engineers the writer quoted casts a vicious slur upon that organization. For how could Mr. Phelps be a member in good standing of the Institute if he had not the attainments and experience necessary to qualify him? Leaving out of account Mr. Phelps' years of faithful service as treasurer and member of the Institute council, we assert that he is fully competent, as an educated gentleman, an electrician and a business man, to fill any position within the gift of the Institute.

### *ANENT TWO ESTEEMED CONTEMPORARIES.*

It was natural that the *Electrical World* should devote 16 pages and 42 illustrations in its issue of April 21 to a description of the Postal Telegraph Cable Company's new building, the officers of that company and offices which that journal is to occupy in the building. Parenthetically, it would be a good idea for the *World* to follow its own illustrations when it begins to furnish its new offices!

It was also natural in the light of past events that the *Electrical Engineer* should devote 24 pages (out of a total of 28 reading pages) and 37 illustrations in its issue for the same week to a description of the same thing—barring the *World's* offices.

The Postal Telegraph-Cable Company profited considerably by the transaction in the matter of free advertising and is doubtless now engaged in congratulating itself over occupying the position of the bone of contention—especially as the bone has been so thoroughly dissected.

In passing, we may state that the most interesting feature of this new building is the installation of Sprague-Pratt electric elevators—an epoch-marking invention—which was presented fully last week to the readers of the ELECTRICAL REVIEW in a page and a half of correct description and two illustrations. And as a postscript it may be added that the readers of the ELECTRICAL REVIEW got something more for their money than a mass of pictures and words devoted to gratuitous puffery—the REVIEW was as comprehensive as ever. Let the reader invest 30 cents in the three publications named and judge for himself—and if he prefers a beautiful, wide-spreading, symmetrical shade tree to a one-limbed, verdure-stripped trunk he will again as always before pronounce in favor of the ELECTRICAL REVIEW.

Finally, we may expect to read in forthcoming issues of one or both of our esteemed contemporaries eulogistic pæans of praise for their one-sided enterprise in this matter.

Our comic contemporary *Judge* remarks with warmth:

"An effort has been made to turn down the word "Hello" in telephone offices. You might as well try to burn an iron dog with a burnt match. It is precisely the word for the business, and it is as much a part of the discovery as the machine itself. It is short, sharp, euphonious, decisive, alert, electric. It comes trippingly to the tongue, and goes off with a snap. And it will live long after its enemies have ceased to utter its opening syllable."

# CORRESPONDENCE.

## OUR BOSTON LETTER.

The old Electric Forging Company has been reorganized at Berwick, Me., under the title of the Boston Electric Heating and Forging Company, with a capital stock of $1,000,000. G. D. Burton, of Boston, is president of the new concern, and F. J. Hutchinson, of Hyde Park, treasurer.

The petition of the American Bell Telephone Company for an increase of capital has been tabled in the house, pending the report of the Committee on the Revision of the Corporation Laws, which is expected to contain an anti-stock watering clause. It is deemed by the Committee on Mercantile Affairs best that the bill of the Committee on Revision of Corporation Laws be passed on before that of the Committee on Mercantile Affairs.

The Campbell Electrical Supply Company, of this city, have just gotten out a reduced price list of their Century insulated tape, which will be of interest to all users of this line of goods. "Century" tape is too well known among the trade to need any further indorsement, and the reduction in price will undoubtedly lead to big sales. The Campbell company will have an interesting announcement to make in our next issue, as they have added another to their long list of good things for the trade.

The second dinner of the electrical fraternity of Boston, was held at Young's Hotel, on Friday evening the 20th inst., the main object of the gathering being to receive the report of the committee on organization and to ratify the same. About 30 prospective members and guests gathered around the board, Mr. W. J. Denver occupying the chair, and after enjoying one of the best culinary efforts of this famous hostlery, the real business of the evening was taken up. Col. E. H. Hewins, speaking for the committee, presented a brief outline of the plan of organization, and an equally informal set of by-laws, which after some little discussion were unanimously adopted. The name by which the association was to be known, as finally agreed upon, was the "Electric Potential," and this momentous question being disposed of, and those present being enrolled as members, the election of officers for the ensuing year was next in order. These officers consisted of a president, two vice-presidents, a secretary and treasurer; the gentlemen being nominated and elected by acclamation. The choice of the members was quickly demonstrated as follows: President, Chas. W. Holtzer; vice-presidents, Frank Ridlon and Col. E. H. Hewins; secretary, A. C. Shaw; and treasurer, I. H. Farnham. President Holtzer, after thanking the society in a few well chosen words for the confidence reposed in him, and asking for the aid of each and every member in contributing to the future success of the organization, called on Mr. Ridlon for an expression of opinion as to the best course to be adopted, to which he responded in his usual happy vein.

Boston, April 21. H. G. T.

## OUR CHICAGO LETTER.

The Chicago offices of the General Electric Company have been removed from 173 Adams street to the Monadnock Block.

Mr. C. H. Macloskie, late electrical engineer of the Intramural Railway, has accepted an engagement with the General Electric Company, and will be located in the designing department at Schenectady. He will still retain the associate editorship of Armour Institute magazine.

The J. C. Hubinger Company, of Keokuk, Iowa, contracted with James Sterritt to bore a well at the electric light plant. A portable boiler used by Sterritt exploded about nine o'clock Wednesday morning, killing the contractor, a laborer, a bystander and Charles Jones, an employé of the station.

Cushing & Morse, general western agents of Kerite, are sending out a neat little package of court plaster, bearing the very attractive wording, "Stick to us and we will stick to you." It may be added that Kerite customers have no reason to complain of the excellent treatment they have received from this active firm.

The Chicago Telephone Company has brought suit in the United States court against the Chicago Electric Protective Company for the alleged infringement of a patent. The plaintiff owns the patent on the McClelland district alarm box and claims that the alarm box used by the defendant is an imitation and infringement. The suit is for an injunction and damages.

Mr. Henry T. Clarke has begun a suit in equity against the Thomson-Houston Electric Company, the Omaha Illuminating Company, the Northwestern Electric Light and Power Company, and the various officers and stockholders of these concerns. The Thomson-Houston company last Fall obtained a judgment for $7,000 against the Illuminating Company, in which company Clarke owns 602 shares. He claims the judgment was obtained by collusion among the officers of the two companies for the purpose of mixing up affairs and defrauding him.

Chicago, April 21. F. De L.

## The Pollard Lamp.

The suit of the Edison Electric Light Company against the Boston Incandescent Lamp Company for infringement of patent in the manufacture of the Pollard lamp, came up for hearing in the United States Circuit Court before Judge Colt, Boston, on Saturday the 14th inst.

The hearing was very brief, the testimony on both sides consisting chiefly of affidavits, and nothing materially new in this line of litigation was developed.

The defendants contend that their method of manufacture is a decided improvement over the Edison invention, and that their substitution of silver dust for lending-in wires is a material advantage in cheapening the cost of production.

Judge Colt retained the papers, and will hand down his decision as soon as possible.

## Wall Street and the Electrical Stock Market.

The Wall Street Market for stocks and bonds during the week has been very narrow, professional and quiet with bearish tendencies predominating. The advancing movement of the last few weeks spent its force after crystallizing the market on a higher basis.

Trade reports show that the threatened labor troubles have already become a disturbing factor. There is a greater distribution of produce than has ruled for some time, although at low prices. Twenty-nine concerns stopped work during the week on account of the strikes, and 25 resumed work or increased forces. Freight rates all over the country are more or less demoralized.

The electrical stock market for the week is at a standstill. Western Union fluctuated between narrow limits, and closed the week at 84⅞. The Collateral Trust 5's were in considerable demand, advancing from 105⅞ to 107.

Edison Electric Illuminating of New York on limited transactions advanced from 102 to 104⅛. The 5 per cent bonds were strong at 104½. Edison Electric Illuminating of Brooklyn had one sale of record at 107⅞. On the 18th inst. the stockholders at a special meeting voted to increase the capital stock of this company from $2,500,000 to $3,000,000. Part of the $500,000 to be thus raised will be used in extending the system so as to light the city under the contract just made. The privilege will be given stockholders to subscribe to $375,000 of the stock at par. The balance will be held in the treasury of the company for future needs. The Edison Electric Illuminating Company of Boston declared a quarterly dividend of 1½ per cent payable May 1. Books close April 17 and reopen May 2.

North American sold at 4⅞ to 5⅛. Mr. H. C. Payne, vice-president of the Milwaukee street railway company, owned by North American, says that interest on that company's bonds due June 1 has not been earned and cannot be paid.

General Electric showed some little activity advancing under manipulation from 40½ to 42¾, and then reacting to 40¾. Wall Street has about reached the conclusion that 40 is the intrinsic value of this stock at this time. It was stated during the week that the bull pull, formed some time ago, had again taken hold of the stock and proposed to work it up. Friends of Westinghouse have grown very assertive of late in praise of the latter company. They say it is making prices so low as to afford General Electric a very small profit on the cash business obtained, and that it can take business lower than General Electric. I do not venture an opinion of these statements. Although it can be said, that General Electric has certainly improved its position in this respect through economies enforced in its operations.

The one absorbing topic of interest in General Electric affairs at the present time is the action which it proposes to take to correct the impairment of capital. The New York State laws stipulate that dividends of corporations are payable out of surplus earnings. There can be no surplus earnings while the capital is impaired, consequently, General Electric cannot pay dividends until such impairment is rectified.

The board of directors have not held a meeting since the annual meeting of stockholders, consequently, no official action has been taken regarding the impaired capital. The matter has been a subject of consideration by the directors and their counsel, but as yet no tangible conclusion has been reached. All plans considered thus far, in the opinion of one of the directors with whom I talked, could not be executed without unanimous consent of shareholders. I am informed that the directors will meet early this coming week at which time this matter will receive consideration.

The two new directors authorized at the annual meeting have not yet been elected, neither have the officers for the ensuing year been chosen.

On the Boston Exchange Bell Telephone was steady at 188 without change. Erie Telephone at 46½ to 46¾; New England Telephone, 54, 55; Fort Wayne Electric, 2 to 3.

There was considerable buying of the Westinghouse issues on the improvement which has taken place in the business of that company. The preferred sold at 52, which is two per cent above par, and the assenting at 38 on a par of 50.

There has been a material advance in the prices of telephone stocks in the month as is shown by the following table:

| | March 17. | | April 21. | |
|---|---|---|---|---|
| | Bid. | Asked. | Bid. | Asked. |
| American Bell | 179⅛ | 180 | 188 | 188¼ |
| Erie | 33 | 36 | 46¾ | 47 |
| Hudson River | 30⅝ | 31¼ | 33 | 35 |
| Mexican | 70¢ | 75¢ | 1 00 | 1 10 |
| New York & New Jersey | 96½ | 98 | 96 | 97½ |
| New England | 49¾ | 50 | 54 | 54½ |

Matured judgment has shown capitalists that large investments rather than patents control the telephone business.

Of the inactive telegraph stocks of importance Postal advanced from 61 bid to 63 bid. The others were about stationary.

Of the inactive electrical stocks, Edison Illuminating of Boston advanced from 110½ bid to 116 bid. United States Illuminating Company, which a month ago was bid 30, is now bid 38. The quotations of the preferred were 49 and 52, respectively. Interior Conduit and Insulating, which has not received a quotation for some time, was bid 35 and held at 45.

New York, April 21. Bain.

## Porcelain Tubing.

The Metropolitan Electric Company, Chicago, reports a large trade in porcelain goods, especially tubing for joists. Varying lengths, up to 40 inches, are carried in stock to meet the demands of the trade.

The Bell Telephone Company, of Missouri, is putting up a number of cables in St. Louis, and the citizens are rejoicing over the reduction of aerial wires thereby.

### General Electric Company's Triphase Apparatus.

The apparatus employed by the General Electric Company in its three-phase power transmission work has all been designed with a view to obtain high commercial efficiency and close regulation. The illustrations on this page show a 300 kilowatt three-phase generator and a 15 horse-power three-phase induction motor. In the generator the armature and field coils are all highly insulated, so that the danger of accidents is reduced to a minimum, and fairly high voltages may be used with the certainty of obtaining a thoroughly reliable machine. The bearings are self-aligning and self-oiling, and the armature being carefully balanced upon rigid supports, the machines run with scarcely a tremor. The magnetic circuit and the windings are so proportioned that the machines run exceptionally cool and require little or no attention to the rheostat even under considerable changes of load.

In the large direct driven machines, and in all cases in which light weight is essential, the magnetic circuit, aside from the armature, is composed of cast steel. The standard periodicity employed is 60 cycles per second, 7,200 alternations per minute. This is sufficiently high to permit the ready use of incandescent and arc lamps and the employment of all standard transformers. It is also low enough to permit the use of induction motors under the most advantageous conditions, and to avoid trouble from self-induction and capacity effects on the line, except at very great distances.

Certain of these machines are arranged to run at 33 cycles, which periodicity is that adopted for very long work in order to reduce the induction and capacity effect on the line, and in plants where the use of rotary three-phase continuous current converters is of prime importance. All of these three-phase generators can be arranged for direct driving from Pelton wheels, and the larger units lend themselves with facility to direct coupling to turbines. They are said to have an efficiency of at least 90 per cent, rising to 95 per cent in the largest sizes.

With slight changes they can be used as self-starting synchronous motors. They come up to speed under light loads without the intervention of clutches or starting motors. They are fully as efficient as the generators, run in absolute synchronism with them, even under heavy overload. Synchronous motors are of especial value in power transmission, as by strengthening their fields it is possible to compensate for loss of voltage due to induction in the line.

Fig. 2 shows a General Electric 15 horse-power three-phase induction motor. These motors are substantially equal to good shunt wound motors, but have no moving contacts, the only connection with the outside circuit being through the three binding posts on the top of the motor. The magnetic part of the field and armature is constructed of annealed laminated iron. The current from the outside circuit passes through windings imbedded in the stationary field punching. The winding of the armature has no connection with the electric circuit, but is short-circuited on itself through a small number of heavy copper bars united at the ends by connectors. It is furnished with a starting resistance placed within the armature spider.

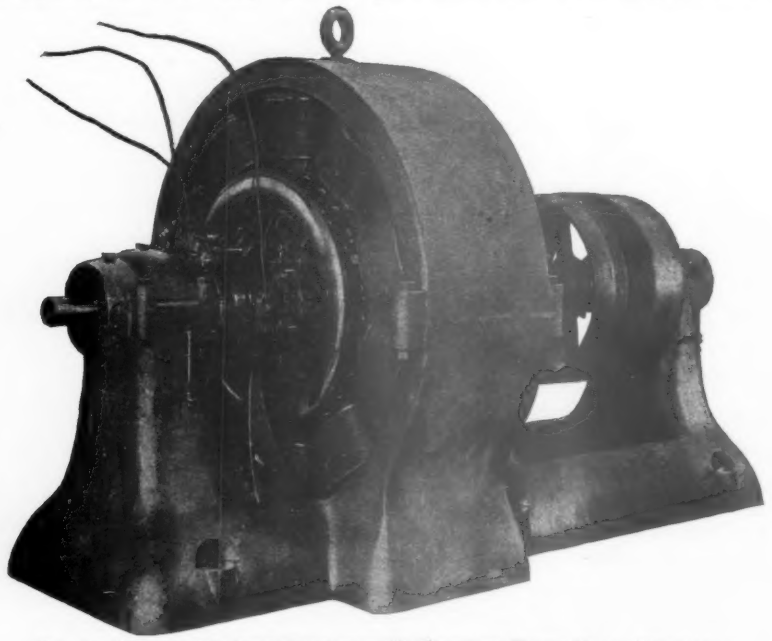

FIG. 1.—GENERAL ELECTRIC COMPANY'S 300 KILOWATT THREE-PHASE GENERATOR.

FIG. 2.—GENERAL ELECTRIC COMPANY'S 15 HORSE-POWER THREE-PHASE INDUCTION MOTOR.

### American Institute of Electrical Engineers.

The eighty-sixth meeting of the Institute was held at 12 West Thirty-first street, New York city, April 18, President Houston in the chair. The secretary announced the death of Dr. Franz Schulze-Berge, at Brooklyn, on March 21, and stated that an appropriate obituary notice would be printed in the *Transactions*.

Upon recommendation of the Committee on Units and Standards, an informal vote was taken expressing the sense of the meeting as favorable to the passage of a bill by the United States Congress, legalizing the electrical units adopted by the Electrical Congress of 1893, at Chicago.

The paper of the evening was read by Mr. I. H. Farnham, of Boston, on the "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," and was profusely illustrated with lantern slides. The final views showing the electrolytic action of the current, were watched with great interest by an audience of over 100. The discussion was opened by Professor Plympton, of Brooklyn, and participated in by Messrs. Kennelly, Emery, Waldo, Houston and others. A communication upon the subject was also read from Mr. Lockwood. Other communications from Professor Thomson and Mr. Lemp were received too late to be read at the meeting. The slides used have been sent to Mr. A. V. Abbott, at Chicago, who will represent the author at a meeting of the western members to be held at the Armour Institute, April 25.

Mr. Elmer G. Willyoung, chairman of the Local Committee at Philadelphia, who was present, informed the secretary that active preparations were being made in that city for the coming annual and general meeting of the Institute, May 15, 16 and 17. The Engineers' Club has offered to throw open its house for the use of the Institute, and it is proposed to make the Bingham House the headquarters. The first meeting of the Institute after its organization was held in Philadelphia in 1884, and its return to the Quaker City seems an appropriate celebration of its tenth anniversary, marking as it does the close of the year showing the largest growth in membership since its foundation.

The annual meeting will be held in the afternoon of May 15. At this session the results of the election of officers will be announced and the reports of the council and treasurer read. Other matters to be brought up will probably be the revision of the election rules and recommendations of the Committee on Units and Standards. The annual dinner of the Institute will occur in the evening. Wednesday and Thursday will be devoted to the reading and discussion of papers, the list reported by the committee being as follows:

"Discriminating Lightning Arresters and Recent Progress in Means for Protection against Lightning," Alexander Jay Wurts.

"The Law of Hysteresis (Part III) and the Calculation of Ferric Inductances," Charles P. Steinmetz.

"Alternating Currents and Fuse Wires," Dugald C. Jackson and R. J. Ochsner.

"The Waste of Zinc in Open Circuit Batteries when Standing Idle," Henry A. Lardner.

"Some Storage Battery Phenomena," W. E. Griscom.

"Central Station Economy," C. Reginald Van Trump.

"A Review of the Progress of the American Institute of Electrical Engineers," Edwin J. Houston.

"Standardizing Electrical Measuring Instruments—(a) by the potential method; (b) an improved direct reading potentiometer," Elmer G. Willyoung.

"Experiments with Two-Phase Motors," Louis Duncan.

"Test for Closed Coil Arc Dynamo," Prof. R. B. Owens, of Lincoln, Neb.

"Relative Advantages of Toothed and Smooth Core Armatures," Mr. Alton D. Adams, of Worcester, Mass.

"Resonance Analysis of Alternating and Polyphase Currents," Prof. M. I. Pupin, Columbia College, New York.

The local committee has in view various plans for the entertainment of the visiting engineers.

In the April number of the Institute *Transactions*, Figs. 6 and 13 were transposed, and on page 204, third line from bottom, the word "positive" should be "negative."

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**At a recent mass meeting the citizens of Springfield, Minn., favored putting in at once the electric lights and water works for which $11,000 bonds were voted last year.**

### The Hunking Push Button.

A novelty in its line is the indicating push button illustrated on this page, and recently patented by Dr. C. D. Hunking, of New York city, in which a magnetic needle indicates by its movements the condition of the circuit. It is, in fact, a rheoscope and push button combined, and it is designed for use wherever the simple push button is needed. The magnetic needle with which it is supplied gives visual notice when the current passes, so that the operator of the push button can see at a glance whether or not the circuit is in the

The Hunking Push Button.

proper condition. If the circuit is incomplete the needle will remain stationary. If a constant current is passing the needle will take a rectangular position and keep it until the current is broken. An interrupted current, as when an electric bell is in the circuit, will be indicated by a vibratory movement of the needle, while the intensity of the current will be denoted by the rapidity with which the needle is actuated. The needle will deviate to the right or to the left according to the direction of the current.

The advantages of this improved button will readily be seen, especially when it is known that its cost is hardly more than the ordinary push button.

It can be had of Messrs. Stanley and Patterson, 34 Frankfort street, New York, in burnished bronze metal, or can be made in all the ordinary materials, shapes and sizes.

### Wire Tappers and Telegraphic Racing News.

The extraordinary activity of the Western Union Telegraph Company in the matter of bringing the wire tappers to justice has often excited remark, says the New York *Sun*. The company employs numerous detectives, who are constantly watching all the lines where the race wires are strung, and a general system is in operation in the racing department of the company which involves the expenditure of a very large amount of money yearly. Wire tapping is an exceedingly prosperous game, but one that is never successful for any great length of time, on account of the activity of the watchers of the telegraph company. The theory obtains in some quarters that this is all done in the interests of morality, but as a matter of fact it is a part of the contract that the telegraph company makes with the bookmakers. Those people who think that the transmission of racing news is a simple matter of ordinary business are vastly mistaken. There is a special racing department in the Western Union building, which pays enormous sums to the tracks for the privilege of reporting the races direct from the judges' stand. This news is then sold to bookmakers and pool rooms throughout the country at prices that are startlingly large. In New York the charge in some instances is as high as $100 a day for this information, but it is governed somewhat by the conditions of police activity and other causes. In other cities the price is lower. They give the bookmakers by wire all the figures, the gossip of the track and all sorts of confidential news affecting the price of horses and the odds on the day's races. The bookmakers willingly pay very large sums for this information, but they demand protection. Of course, the information is only valuable to them when it is trustworthy and exclusive. If their customers get it, it places them on even terms with the bookmakers, and the bookmakers are not accustomed to doing business on this principle. Hence, the careless vigilance of the telegraph company wherever there is danger that the wires will be interfered with.

### Meeting of the Stockholders of the Jos. Dixon Crucible Company.

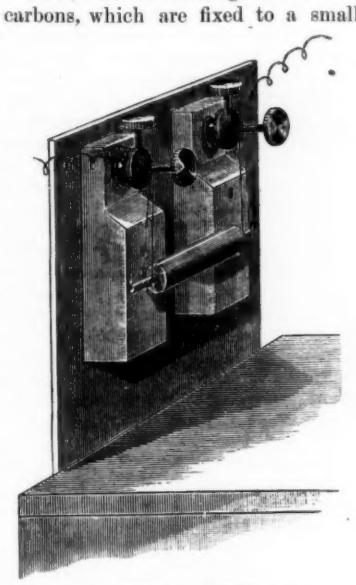
As an evidence that times are not so deplorable as they are said to be, was the satisfactory meeting of the stockholders of the Joseph Dixon Crucible Company, held at their fine offices in Jersey City, N. J., April 16. Out of 7,345 shares 7,215 votes were cast for the same board of managers that has conducted the affairs of the company through its years of prosperity. The vote was the largest ever cast and it was a decided compliment to the members of the board as were also the remarks of some of the largest stockholders. The board consists of E. F. C. Young, John A. Walker, Daniel T. Hoag, Richard Butler, William Murray, Joseph D. Bedle, Jerome D. Gillett. In the organization of the board Mr. E. F. C. Young was elected president; John A. Walker, vice-president and treasurer; George E. Long, secretary. The Dixon company was founded by Joseph Dixon in 1827, and organized as a stock company in 1868.

### AN ADJUSTABLE MICROPHONE.

BY W. H. SOULBY IN LONDON "ELECTRICAL REVIEW."

Though no claim is made to novelty in the following apparatus, yet as it appears to possess certain features which have not hitherto been published, and as experience has proved that the facilities for delicate adjustment are very marked, I have been induced to describe the same.

First, as to the arrangement of the carbons, which are fixed to a small



An Adjustable Microphone.

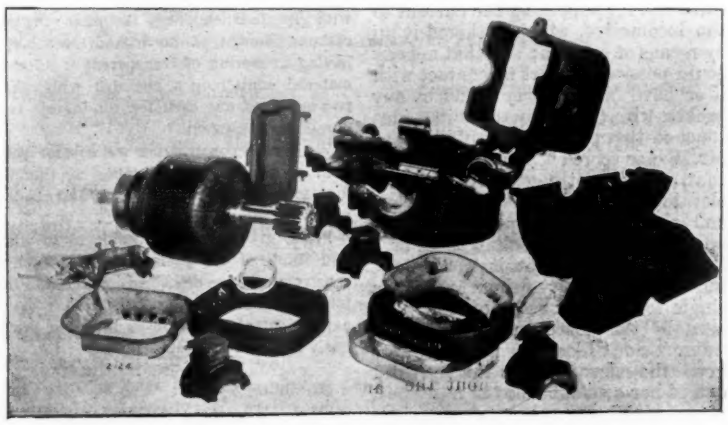
sheet of ebonite about 5x3 inches, which again is fixed to the end of a sounding box (a cigar box does duty in the present case). Two blocks of carbon, each one and one-half inch long by one-half inch thick, are cut down at one end to form a lip or flange, through which the binding screws pass to fasten the carbons to the ebonite sheet. The vertical screws connect the wires conveying the current. The horizontal screws have each a short length of sewing cotton wrapped around them; a piece about eight inches long is doubled, the two ends being brought together, are placed on the screw and wrapped round it, leaving a loop of about one inch long hanging down, at the end of which a noose or slip-knot is formed to carry the reduced ends of a small cylinder or pencil of carbon about one inch long, which remains suspended thereby, and can be raised or lowered by a turn of the screws.

This suspended cylinder of carbon just hangs clear of the fixed carbon blocks. The connecting wires are brought into contact, but no current passes until the carbons are made to touch each other. The sounding box is then slowly tilted up (by means of a wedge pushed gradually under the end of it) till the carbon cylinder rests against the fixed blocks, just lightly enough to obtain the best results, which can be ascertained by placing a watch on the sounding box and the receiver to the ear while adjusting.

A further adjustment for the strength of current can be made by altering the relation of the carbon blocks to each other, the binding screws forming a pivot around which they may revolve; when brought closer together more current is allowed to pass, while by separating them it is reduced. This arrangement, therefore, provides two adjustments—one for making the contact or connection, the other for regulating the current.

Secondly, regarding the effects produced. The difficulty in this instance was to obtain sounds of a suitable strength or pitch, to obtain the best effects from so delicate an instrument. Of course, a watch was the first sound producer tested, and when all was quiet, without any other sound or movement near, it answered very well; but the playing of a piano in one part of the house and the washing of dishes in the other, disturbed everything, including the patience of the experimenter. Upon anyone entering the room, walking about, speaking, coughing, touching the table or door handle, the shriek of the receiver was too much to hear; even at a distance its repeated inarticulate cry became most harassing, though only an ordinary receiver was used. After attaching a longer length of double wire and retiring to a distant room, the sounds still retained their intensity in the receiver, every word spoken in the other room being recognizable when not too loud, and the ticking of the watch was very distinct, even to the metallic ring of the hair-spring as it coiled and uncoiled at its work.

Some very successful microphones have been constructed, but considering the cheap and simple arrangement of the one described, the results must be considered very satisfactory. The current was supplied by three small Leclanche cells, the receiver being a small adjustable watch telephone.



Parts of General Electric Company's G. E. 800 Railway Motor.

### General Electric Railway Motor.

The standard General Electric railway motor is the G. E. 800, the parts of which are shown in the cut. Its light weight and simplicity of construction and manipulation have rendered it a general favorite among street railway men. By its use is claimed a decided economy in track expense and diminished maintenance and repair charges. The armature is of the iron-clad type with embedded winding. The bearings are lined with the best quality babbitt and the brushes are readily accessible. When the motor is mounted on the axle and closed it is both water and dust proof, and with the Type "K" controller is claimed to form an invincible pair.

## THE ELECTRIC RAILWAY.

A LECTURE IN THE COOPER UNION ELECTRICAL COURSE DELIVERED BY T. COMMERFORD MARTIN.

My subject to-night is one that embraces many topics you have already been addressed upon—batteries, generators, motors, measurements, etc., but contains some elements and features peculiarly its own. I have been a little uncertain just how I should handle it, one reason being that it is an outdoor subject, while I understand my audience to consist primarily and largely of those who are practically engaged in indoor electrical work. It has occurred to me, therefore, that in order to avoid the weariness of repetition of what has gone before, as well as to give a graphic picture of what an actual, operating, successful electric road is, I might do well if I presented the subject in the shape of a brief narrative in two parts. You probably know as well as I do that electric railway work divides itself into two parts sharply, namely, that which is and that which might be, that which we have got and that which we would like—that which the practical man deems possible and that which the inventor and a large portion of the public want, because it promises better conditions. I will divide my story broadly on those lines. The first part will deal with an electric road that might be anywhere and is of the kind built every day; and the second part will touch on the conditions that even now govern in such cities as New York, and must be faced by the successful railway man of the future.

We will assume to-night that one of my hearers, Mr. A. D. Vance, who allows me to tell his story, is the owner of a line of horse railway in the prosperous town of Tariffville, suburb of a great city; and that having made a little money out of its operation by animal power, he wishes to see if he cannot make more money and give better service by adopting electric motors. This well-to-do self-made citizen, who has won his way in the world by steady work intelligently applied, is rather hard-headed, not particularly enthusiastic or imaginative, but ready to use a good thing if it commends itself to his judgment, or especially if somebody else has made it a success. In the case of electric railways, he would, of course, take no risk in making the change. The burdens and losses of pioneer methods were borne by other people long ago, and he could at once put approved apparatus on his road and increase its earnings while giving the public greater comfort and facilities. He can, however, if he wishes, try some of the new things which are said to be so much better than the old. There will be some risk in it. It may make him poor, it may make him richer. Whether he will be content with the old methods or not, depends in some degree on his courage, on his being a true American; but if he can regulate his enterprise by a little knowledge of electricity it will do him no harm. An institution is not essentially bad because it is old, nor is it necessarily good because it is new. There are some things also that it is better not to do by electricity, but what they are, perhaps some of my fellow lecturers will tell you.

The first step towards "electrifying" the horse road at Tariffville is getting permission to do so. The State Railroad Commission raises no objection, but the public and the aldermen still have to be convinced. In some cases this is a difficult and expensive process. I refer, of course, to a campaign of reason and argument, for the town is full of shrewd, sensible workingmen, and while one or two of the local newspapers have talked wildly about the "deadly trolley," these citizens know that 500 other communities would not have adopted electric traction unless it had as many advantages for the public as for the capital invested in it. But even such a campaign of education is rather expensive, as the town council decides to leave the matter to public vote, the street railway company footing the bill. One or two public meetings are held. Literature is circulated showing that the trolley current never killed any human being, though it may have given a really happy despatch to a few worn out dray horses; and statistics are scattered broadcast, proving that in the way of developing a live factory town electric traction is 10 times better than even an increase or a reduction in the tariff. The company carries the day by an overwhelming majority, but when its franchise comes out of the aldermanic chamber, it has a few special provisions that the company and Mr. Vance would rather dispense with, but which can hardly be called improper. One is, that for an hour before and after the factory whistles blow, and between noon and one o'clock on week days, the fare shall only be three cents. Another is that the company shall not use T rail, and shall pave the streets it runs through. Another is that the company shall place lights on its poles at frequent intervals. Another is, that the feeders shall be placed underground, and that over the trolley wires shall be guard wires. The last condition of any importance is, that the company shall not run its cars in the city proper at a higher speed than six miles an hour. These conditions are mentioned here because they have a great influence on Mr. Vance's purchases and plans, in a way that I will try to bring out as our narrative proceeds.

Even to secure such terms as these was not easy. Tariffville is an ambitious place, and some of its people who had been to the World's Fair wanted to start in with an elevated electric road such as they have seen there working most beautifully and carrying 80,000 people a day. They explained that this road had simply a third rail for supplying the current to the locomotive, which gathered it up by means of a brush; and that nobody could possibly be hurt by contact with it or have his property burnt by any broken wire. This metropolitan idea touched the pride of Tariffville, but Mr. Vance scored a point by showing that, to say nothing of its cost, an elevated structure would be heavy and clumsy, that it posts would be much more frequent than those of a trolley line, and that it would take hundreds of trolley wires to make a single lengthwise beam of the kind used by the dozen in elevated railways. So Chicago was allowed to keep the elevated electric road for one of her own suburbs 125 miles out. A proposition much more earnestly advocated was that the franchise should insist on storage battery cars, and for a time it really looked as though that plan would win. These cars needed no overhead wires, it was pointed out. They were charged at the station and were then good for many miles' service without recharging. Mr. Vance had, himself, a sneaking belief that they might do, but he was a little afraid. He did not know how long the batteries would last, and nobody seemed quite sure how much it cost to run such cars. So he contented himself with referring to two indisputable facts, namely, that Tariffville was very hilly and that in Winter the snows were very heavy; and he insisted that such conditions placed storage cars beyond consideration for the present. That settled it. He was equally successful in staving off the conduit system, with its wires snug underground out of sight. Tariffville is built on a granite ledge, and to have laid a conduit would have cost many thousand dollars a mile for excavation, construction, drainage, etc. Mr. Vance admitted all the good points of the conduit, but put down his No. 11 brogan very firmly and said that if it was to be a conduit franchise he'd stick to horses yet awhile. I shall refer to these points again later on.

*(To be continued.)*

## QUESTIONS AND ANSWERS.

BY OUR "QUESTION EDITOR."

ANENT THE "ELECTRICAL REVIEW."

To the Editor of Electrical Review:

Can any adherent of electricity, be he engineer, professor, student or inventor, afford to be without weekly visits of the Electrical Review? I think it contains much valuable information which could not be obtained otherwise. Eager Reader.

Washington, April 10.

This is rather a difficult question to answer, owing to its personal character and the modesty of this journal's staff. However, the only answer is "No!"

PROFESSOR ANTHONY'S PAPER PROVOKES AN INQUIRY.

To the Editor of Electrical Review:

Incidental to the paper "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp," read before the American Institute of Electrical Engineers by Prof. Wm. A. Anthony, March 21, 1894, and which has been given space in your esteemed publication, the Electrical Review, issues of March 28 and April 4, 1894. What about the practicability of an incandescent lamp in a manner having *no chamber?* or in other words, to have the glass molded or blown against, surrounding and between the positive and negative ends of the U shaped carbon filament, or, as a modification, to have the U shaped opening in the glass bulb large enough to insert the carbon filament afterwards with vacuum or bromine method? The main claim of improvement will be each end of the carbon filament surrounded with glass independent of the other; or, the carbon filament of an incandescent lamp having a covering of transparent or suitable material containing a chamber which has two openings, one each for the ingress and egress of the current.

With such construction we control both the laws of refraction and reflection, thereby increasing greatly their efficiency and candlepower by natural optical laws.

Please give me your opinion as to what you think of the practicability of such a construction as described. Would the intense heat crack or break the glass? Have experiments been made in this line previously? Very respectfully,

A. H. Hieatzman.

Baltimore, April 9.

Mr. Hieatzman is referred to United States Patent No. 322,498, issued July 21, 1885, to Philip K. Stern. It would seem that the idea had been anticipated in this patent.

RELATING TO PI.

To the Editor of Electrical Review:

I would like to know what the sign "$\pi$" means. I see it in books and all technical articles. You would very much oblige me by answering this. Respectfully yours,

Detroit, Mich., April 9. B. B.

The character is used to denote the ratio of the diameter to the circumference of a circle. Its value is 3.1416.

AMERICAN BELL VS. WESTERN UNION.

To the Editor of Electrical Review:

I read the following item in the New York *Tribune:*

Boston, April 10.—The case of the American Bell Telephone Company against the Western Union Telegraph Company, which has been pending in the United States courts for years, was heard to-day before Judges Putnam, Nelson and Webb, in the United States Circuit Court of Appeals.

Kindly tell me briefly what this suit is about and oblige.

Yours respectfully,

Cincinnati, April 18. W. H. S.

The essence of the case is as follows: The American Bell Telephone Company or its predecessor made originally short license contracts. Later when these licensee companies became well settled and were doing a lucrative business, the American Bell Telephone Company gave them perpetual licenses, the licensee companies agreeing to give the parent company a certain amount of their stock. It now appears that the Western Union Telegraph Company claims that it is entitled to just five per cent of such stock, and figuring on $20,000,000 of stock the Western Union claims about $1,000,000.

ROTARY STEAM ENGINE—COURT DECISION—COST OF PATENT.

To the Editor of Electrical Review:

Would like to ask a few questions, which I think you are better prepared to answer than anyone else:

1. What is the present status of the rotary steam engine, and what are deficiencies of such that have been on exhibition at different times and places?

2. What was the decision of the court in a case which was tried several years since, where an employer claimed the benefit of an employé's patent on the ground that the employer was entitled to the benefit of all the employé's time, etc.?

3. About what would it cost to procure a patent on rotary engine, provided such device should prove to be worth patenting?

W. L.

Manitou, Colo., April 10.

First. The rotary steam engine, so far as we are advised, has not been up to the present time a success. Exactly what the deficiencies are we are unable to state; one, however, is the inability to utilize all the expansive force of the steam so that when the latter exhausts into the air it has not delivered complete expansion of all of the energy contained. Other difficulties arise by reason of surface friction.

Second. The decision of the court in the case of the employer and the employé will be found in the Electrical Review for May 16, 1891, page 167.

Third. The cost of a patent varies with different attorneys for competent work. You can estimate on about $100 for the entire expense.

### Brooklyn, N. Y., Trolley Lines.

The DeKalb avenue is one of the best managed trolley lines in Brooklyn. President Partridge and Superintendent Heins have made this road popular with all patrons. It is the only Brooklyn line running "trailers" during the rush hours of morning and evening. The Ninth avenue line, in the same city, is the most uncomfortable to ride on, but the passengers are hoping for an improved track.

### ELECTRIC RAILWAY NOTES.

The American Street Railway Association will meet at Atlanta, Ga., on October 17.

It is rumored that there may be some changes in the *personnel* of the Buffalo, N. Y., Railway Company.

The Vail rail bond, recently designed by Mr. J. H. Vail, of New York, is meeting with considerable popularity.

The next regular meeting of the New York State Street Railway Association will be held at Syracuse, on September 18.

The St. John, N. B., Street Railway was sold at auction last week, and was purchased by a Montreal syndicate for $92,000.

People at Grand Island, Neb., claim that an electric road is an absolute necessity for that city, and say they want one right away.

Brooklyn, N. Y., citizens think that tinkle bells operated from the car axles of the trolley cars would be better than the gongs now used.

For lack of cars, the Muscatine, Ia., Electric Street Railway Company has reduced their service to a 30 minute one. The citizens are offering protests.

People in Atlanta, Ga., are objecting because the Atlanta Traction Company and the Consolidated Company are not keeping their cars on schedule time.

Terry's Island, in the Connecticut River, opposite Enfield, has been sold to a syndicate, which will build a dam there to develop power for supplying towns with electricity.

Work has been progressing on the Lynn extension of the Wakefield and Stoneham, Mass., Street Railway the past week, whenever the weather permitted, and the road is about completed.

The mortgage of the Nassau Electric Railroad Company, of Brooklyn, N. Y., for $6,000,000 was filed on April 18 in the County Clerk's office. The money was secured to begin the construction of the road.

Two men at Hazleton, Pa., tried to kill themselves by lying in front of a trolley car. They prepared for the act by baring their bodies above the waist. A car struck them but they were not seriously hurt. They were supposed to be crazy.

An electric railroad from Worcester to Boston, *via* Milford, and passing through Upton, Mass., is being agitated. If towns will give a franchise and take part of the stock, it will be organized. A meeting to consider the matter may be held at Upton before long.

There are 43 electric railroads in Europe, employing 538 motor cars and locomotives, and 151 trailers. The systems are divided as follows: Trolley, 31; central rail, 8; underground conductor, 2; storage battery, 2. There are 24 lines now building, all of which will probably be running before the year is out. A large number of the systems used are American.

Work on the power house for the Mt. Carmel and Shamokin, Pa., Electric Railway Company has been commenced. The power station is located in the mountains between the two towns where a culm bank is available for fuel. It is expected that the road will be in operation about July 1, and that an extension will eventually be built beyond Mt. Carmel.

The controlling interest in the Oshkosh, Wis., Street Railway Company has been sold to an Indianapolis syndicate for a private consideration. The sale is conditioned upon the granting by the common council to the new company a franchise for an electric line. The purpose is to reorganize and install electricity and make generous extensions. Representatives of another syndicate are also after a franchise.

The suit of Elbert Scott against the Savannah, Ga., Street Railroad was tried in the city court recently. Scott was eating cheese and crackers in one of the cars February 2, 1893. He was ordered to stop by the conductor, which he claims he did. He threatened several times to report the matter to the superintendent of the company, whereupon the conductor put him off. He brought suit for $1,500. The jury returned a verdict for $100.

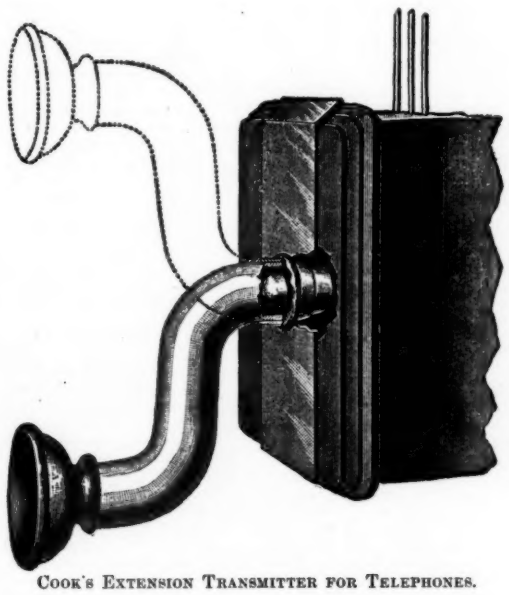
The Union Railway Company, of New York, completed a deal last week, which will enable it to run trolley cars from 129th street to New Rochelle. The company has been trying to acquire this right during two years past. It succeeded in getting the required consent through all the towns and villages except South Mount Vernon. The citizens of that village steadfastly refused to hear the plan. The company, in consideration of the franchise, pays to the village treasury $6,500 cash and agrees to carry passengers from Harlem to Mount Vernon city line for five cents each. The $6,500 was paid as soon as the contract was signed. By the terms of the contract the franchise will be forfeited if the road is not in operation by June 1. The fare from Harlem to Mount Vernon city will be 10 cents, and to New Rochelle 15 cents.

### Breed's Trolley Repair Wagon.

The New England Engineering Company, of Waterbury, Conn., announce in the REVIEW this week an emergency wagon that will attract the prompt attention of every practical electric railway man. It is Breed's emergency wagon for trolley construction and repairs.

President A. M. Young, of the New England Engineering Company, is a practical electric railway builder and his endorsement of this wagon, which he gives unqualifiedly, will assure it an immediate welcome from all electric railway companies needing such a convenience—and they all do need it. The tower of the Breed wagon is easy to raise and lower, a man can do it with one hand, and it locks instantly. It is a cheap and practical wagon, worked out by one familiar with the every day demands of electric railway construction and repairs.

The New England Engineering Company are arranging to build these wagons in large numbers. Every wide-awake, progressive railway company will want one, and when once in use we predict they would not be without it for several times the cost.



COOK'S EXTENSION TRANSMITTER FOR TELEPHONES.

### Cook's Extension Transmitter.

The illustration herewith shows an extension transmitter for telephones patented and manufactured by V. A. Cook, Averill Park, N. Y. It is claimed that the use of this device improves the telephone service 50 per cent, because the sound waves are concentrated in the curved tube, passing in an indirect manner until they reach the oval plate in the tube, which is larger than the diaphragm of the telephone, and thus acts as a protection to it, when they are separated before reaching the telephone diaphragm. In this way an equal quantity of sound is constantly vibrating the telephone diaphragm, no matter what kind of a voice is speaking. Persons should talk in a natural tone of voice when using a telephone; but if they do shout or speak loud when using the Cook extension transmitter, it is said to be impossible to rattle the telephone or to displace its adjustment. The extension transmitter is made of brass, which has great acoustic properties, and heavily nickle-plated, which gives it a handsome and ornamental appearance. The tube can be turned so as to be adjusted to the height most convenient to the person using the telephone.

## TELEPHONE NEWS AND COMMENT.

President Samuel Bryan, of the Chesapeake and Potomac Telephone Company, Washington, D. C., is to be congratulated over the result of telephone legislation at Annapolis. A very satisfactory and fair bill has become a law. A commission of three is created, and while all subscribers are permitted to use each other's telephones, non-subscribers are not permitted to use any telephone except the regular pay stations. This is a most commendable move. The non-subscribers may be indicted for using a subscriber's telephones and the subscriber indicted for permitting it. This should, to a large extent, stop telephone dead-headism—one of the most pernicious evils telephone companies have to deal with. Mr. Bryan seems to have captured the fancy of one of the Baltimore reporters. The *News*, in its Annapolis dispatches of March 2, says:

President Bryan of the telephone company is still here, smiling suavely and joking politely with all whom he meets. Mr. Bryan is perhaps the most affable and agreeable corporation officer that has visited Annapolis for many years. His manners are perfect. He knows how to talk to everyone. "He is not stuck up," as one county member said, "but talks just as easy and nice as if he had known me all his life." A shrewd politician, who is well up in all that goes on here and has gone on for years, said of Mr. Bryan last night: "Bryan is one of the 'slickest articles' that ever turned up here. He can talk with a farmer and please him, and he can talk with the sharpest lawyer here and hold his own with him, and he can give the members of the third house points."

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The day is some distance off before we can telephone without wires.

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All the telephone companies report an increase of subscribers again. The hard times of 1893 caused a falling off.

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There are a number of restless Bell licensees these days, but they don't seem to find anything better to suit them.

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There is no boom in the stocks of local telephone companies, but there is a steadiness that doesn't indicate much of a panic on account of the newly organized opposing companies.

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Something new in the telephone line may be announced any day. It will be a practical telephone system backed by a name that will convince all who are at all familiar with telephone history of its value and importance.

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Mr. Frank B. Knight, of Austin, Tex., is compelled to keep his eyes open these telephonic days. Scarcely an afternoon passes in Texas without a new anti-Bell company being formed, and Mr. Knight as special agent of the American Bell must proceed to investigate. Mr. Knight's talented daughter, Miss Grace, was recently portrayed in a leading Austin journal as a conspicuous beauty of the State.

## ELECTRIC LIGHTING.

A LECTURE DELIVERED AT COOPER UNION HALL, NEW YORK, FEBRUARY 14, 1894, BY PROF. F. B. CROCKER.

(*Concluded from page 192.*)

We are all perhaps interested in the great question of the incandescent lamp at this particular time, because there has been a great deal of litigation on the subject and some very awkward injunctions, etc.; but without going into the merits of the patent case, which is entirely out of my province, I will say that nearly a perfect vacuum is practically required in order to make an incandescent lamp work successfully, and no one has yet devised any lamp which will work except with a nearly perfect vacuum. The language of Edison's patent is very strong in regard to the vacuum—probably a little too strong—but still it is an important feature. The object of the vacuum is to prevent the loss of heat by convexion. In other words, if the filament is in a perfect convexion it does not lose much heat, because there is no material near to it to take up the heat from it and carry it away. Another advantage is that it avoids the so-called air washing effect, and the carrying away of the particles of carbon from it and gradually wearing it out. This is illustrated by the way we have read that water wears away stone. I never thought that it did, but water is supposed to wear away the stone. So in this case particles of gas will actually wear away the carbon. The result is that the incandescent lamp consists of really a globe enclosing it, a filament in that globe, and the air exhausted from the globe, and leading-in wires, which, of course, have to be hermetically sealed so that the air shall not leak in. This (exhibiting) is at about full voltage, and is probably the proper voltage for this lamp.

Now that point is what I come to next. I will assume that the incandescent lamp consists of a globe enclosing the filament, a fine filament of carbon of 100 to 200 ohms resistance, and requiring half an ampere to bring it up to full incandescence, and therefore requiring small wires to feed it with current, a vacuum surrounding the filament in order that the filament shall retain its heat and also in order to avoid the air-washing effect, and that in order to maintain the perfect vacuum the leading-in wires should either have a stopper or be hermetically sealed in the glass, in order that the air shall not leak in.

That is all there is to it, but it required the constant work of some of the brightest minds that the scientific world has ever seen to produce that lamp. It was away back in 1840 and 1850 that the incandescent lamp was first worked upon and by men who were really trying to produce a commercial light, and it was not until 1878 or 1879 that anything like good results were obtained. Mr. Edison worked for one or two years steadily trying to perfect it. Yet when it is perfected we see that all there is to it is a plain carbon filament enclosed in a vacuum and a glass globe surrounding it. My experience in electrical matters has been that progress has always been in the direction of simplicity. Progress is never in the direction of adding complications. It takes longer to make a thing simple than it does to make it complicated. Men naturally invent in the direction of complication. They do not invent in the direction of simplicity.

This brings us to the point of how much current passes through this lamp. What regulates this lamp? Why, it is resistance. We have a certain voltage, probably about 115 volts, and we have a certain resistance there; probably a 32 candle-power takes about one ohm. If that lamp had a less resistance it would take more current. If it had a greater resistance it would take less current. If I introduce resistance here, the lamp dims and shuts off the current. If I cut out resistance the lamp comes up (illustrating). It comes up above its full incandescence when I entirely cut out this resistance. That question of the resistance of the lamp is a very important one in two respects. In the first place, it is the resistance of the incandescent lamp which enables it to maintain its proper point of incandescence. Every lamp has a certain resistance, of course, like every other conductor. You can measure it with a Wheatstone bridge. It may vary with change of temperature, but you can measure it. Every lamp, therefore, will have a certain electro-motive force that will give it the proper current to bring it up to this point of incandescence. That, for instance, is a 100 candle-power lamp. It takes more current to bring it up, but the same voltage, because its resistance is less than the preceding lamp. Its resistance is about one-third of what the lamp was before. Therefore, it takes three times as much current with the same voltage. It consequently has three times the light. That is all there is to it. Every lamp has a critical electro-motive force which will give the proper current through its resistance. You see on every lamp that it is marked so many volts. We all know that. There are certain points, however, that we do not know quite so well; the fact that that resistance is all there is to it and that the only regulator of the incandescent lamp is its resistance. If you bring it up that way (illustrating), you have a higher electro-motive force. If you get any resistance like this, you reduce it. This external resistance has the objection of being wasteful of energy. Just so much as I put in resistance in the external circuit, just so much I destroy energy, because the current has passed through this dead resistance which uses up a portion of the energy. Therefore, the use of an external resistance is objectionable, but for the purpose of dimming the lights in a theater, for instance, to show the image on a screen, or anything of that sort, that would require this dimming effect. We could do it under those circumstances, but usually the introduction of any dead resistance in series with any lamp is objectionable because it destroys energy.

Now, that dead resistance there represents the resistance of the conductors that carry the current to the lamp, and that is the greatest bugbear in electrical engineering—that we destroy a certain amount of the voltage when we pass a current through any considerable resistance and, therefore, we dim the light. In other words, the remote lamps, those lamps that are a long way distant from the central station, would be dimmed and those near the station would be bright. It has taken the greatest amount of invention and of care in wiring and has caused the greatest amount of dissatisfaction on the part of customers, which is all the result of this effect of the resistance in conductors. When I was cutting in and out resistance on this rheostat (indicating), it is precisely the same as though that resistance had been in the conductors. Every time I turned this you might say I moved the lamp 100 feet further away from the dynamos. Now, that in itself is, of course, very objectionable, because we do not want the lamps that are far away from the station to be dim while those nearer the station are bright, but we want them to remain equally brilliant. Furthermore, it is not a practical solution to put low voltage far away from the station and high voltage near the station, because you are sure to get mixed up some time and get the low voltage to far away, and then the lamps will be burned out too. That is not a practical or a feasible thing to do.

Now, there is a lamp burning on a circuit a certain distance away from the central station (exhibiting). Now there is a certain resistance in the wires leading to that lamp from the central station. From the dynamo to the lamp there is a certain resistance due to the resistance of the conductors, and that is represented by this box here. If I turn on another light in that house that lamp goes down (illustrating), and it does not give as much light, the two of them together, as the one did before. What is the reason for that? The reason is that there is a drop in this resistance; that this has a certain resistance. The box is marked 20 volts. Now the resistance must be something like 10 or 20 ohms, I should say, because it is only one ampere; it must be about 20 ohms. There the drop is only about 12 ohms. Now I put this in, and they are both rather low (illustrating). It drops it from 105 down to 95.

That shows you the drop that does occur. If I had one lamp burning and I had put on 10, the drop would be still less. Supposing I have a few ohms; in every one or two ohms the more current I cause to flow through that resistance the less the potential will be here at this point (indicating). And that is just as absolutely necessary as the law of gravitation. There is no way around that. That is one of the greatest bugbears, as I have already said, in electrical engineering—how to get the same illumination in both lamps that we have in the single lamp. That is really the so-called subdivision of the electric light, how to subdivide the current so that no matter how many lamps you put on you have the same candle-power. The only satisfactory solution is to have the lamps so distributed and the wires leading to them so distributed and the resistance sufficiently low, so that each lamp is supplied without affecting the others. One method is to have a number of feeders so that each lamp is quite near a feeder and gets its current directly rather than indirectly; but any resistance whatever in series with these lamps will have the effect of causing a single one to be brightened when the other is taken out. I do not care if that resistance were only a hundredth of an ohm, that lamp would brighten when this was cut out. That effect would exist. The lower this is, the less the effect. It is a difficulty which is quite serious, and, in fact, I should say it was the most serious difficulty in electric lighting. There is no good way around it. Good judicious wiring by distributing your lights in small bunches and not have more than 15 or 20 lights on a circuit at most, and feeding the lights at an intermediate point, feeding them, for instance, at the middle instead of at the end of the circuit, and various methods well-known to wire men are employed. But as to the principle of that wiring which we are all striving for, that is all there is to it. There are a great many men who know 10 times as much about wiring as I do, yet who do not know exactly what the difficulty is, and how it will never be overcome if men have 10,000 years to live. By inventions we can make those facts less objectionable, but they are as absolute as anything can be. Every time that a current of a given number of meters flows through a given resistance in ohms, there will be the products of those two volts drop, so to speak, and you can always get the drop by multiplying the amperes by the ohms.

The ordinary efficiency of the incandescent lamp is something between two and three watts of a candle; that is to say, every lamp requires at least three watts and very often four watts for each candle-power that it gives. If we run up the voltage of the lamp we shall have less watts per candle-power, because the light increases much more rapidly than the electrical energy.

For instance, I will show you one effect here (exhibiting). That lamp is a 100 volt lamp. It is now taking its full current and full voltage. Now, if I increase the current five volts, I will almost double the candle-power of that lamp and the current will be only slightly increased. In other words, an increase of about 10 per cent. in energy will add 100 per cent. to the light. The consumption of a little more electricity will produce twice as much light.

I have a table of figures here which is quite interesting, but, as the hour is late, I won't weary you with them. Five per cent. more voltage and 10 per cent. more energy gives 50 per cent. more light. In other words, by spending a little more energy we get 50 per cent. more light. Conversely: Five per cent. less voltage and 10 per cent. less energy gives only two-thirds the amount of light. That shows us the enormous advantage of slightly increasing our voltage and the objection to slightly decreasing it.

The question might immediately be asked: Why do we not run up the voltage, if we can get 50 per cent. more light by an investment of five per cent. more voltage? The answer to that is, that just as rapidly as we increase the light of the lamp we decrease the life of the lamp; that is to say, the lamp is destroyed rapidly. That is the reason why we do not run up this voltage beyond the point at which it is ordinarily run. No one denies that we get an enormous advantage in efficiency, but everyone will say that any great increase in voltage would make so much less life that the lamp would rapidly burn out.

I will show you what happens when you put a 50 volt lamp on a 115 volt circuit. That is an answer to the question.

[At this point the lecturer experimented with an incandescent lamp, which failed to show the result he anticipated.]

Well, that ought to have burned out, and the drop on the wires is the only way I can account for the fact that it did not burn out. However, you see that lamp gives 20 times it usual light at twice the voltage. That lamp was giving in the neighborhood of 300 to 400 candle-power. In other words, it was almost as intense as an arc lamp, and yet it was consuming very little energy, probably 100 volts and two amperes.

[The lecturer undertook the experiment with another lamp.]

I see there is too much drop on the wires here. I have often lectured on the subject of sparking, saying that if you do so and so such a result will occur, and I have turned the brushes and it wouldn't sparkle a particle.

But you can see the enormous advantage of a slight increase in voltage, because those lamps were only consuming two or three times the amount of energy and they were giving 20 times the amount of light. As a matter of fact, every lamp is run at too great a voltage and too little energy. I believe in working lamps more in that direction. I think too much attention is paid to the burning out of a 35 cent lamp and too little attention is paid to the consumption of 10 dollars' worth of electrical energy. In the life of an incandescent lamp of 1,000 hours it consumes in the neighborhood of 13 dollars' worth of electrical energy. That is to say, the man who burns that lamp has to pay 13 dollars for the electrical energy consumed. The lamp is worth 50 cents at the outside. Now, how absurd it is to save the cost of the lamp and waste any portion of that energy. If we can save 10 per cent of the energy, why, it should be done. Consequently, I say, run the lamps at a higher efficiency and let them burn out more frequently. Mr. Carl Hering read a paper on that subject recently, in which he pointed out the truth of this statement, showing that the tendency is for people to think too much of the cost of a 25 cent light and forget all about the cost of the 10 dollars' worth of energy that it burns. My opinion is that he was perfectly right about it. A number of other men have also advocated the same idea. I think the tendency now is to run lamps at a little higher efficiency, and let them burn out more frequently. His figures show that the most economical point at which a lamp should be stopped is something like 400 or 500 hours: that at 400 hours you ought to smash the lamp if it is not already broken; in other words, that one of the most economical adjuncts of an electric lighting system would be a club to break the lamps that burn longer than 400 or 500 hours.

That is one of the principal points that we should seek to correct in the future. I think that you will realize the importance of it when you compare the amount of energy wasted with the small voltage of the lamp.

I think this is all I have time for this evening, and in fact I think I have already overrun the time considerably, and I thank you for your attention.

## WESTERN NOTES.

**Kenfield and Windsor,** of the *Street Railway Review*, have launched a new publication bearing the title of *Brick*, and, it is needless to say, will arouse as much interest in the building field as they have done in street railway lines.

**South Side Trolley Lines.**—Mayor Hopkins is endeavoring to place an arc lamp on at least three of the poles to be erected in each block. This the company does not want to do, and in place thereof offer to pay down the round sum of $20,000. The yearly interest on this at 4 per cent. is but $10,000. The cost of lighting desired will exceed $25,000, whether done by the city or the railway company. The mayor has stated that he will veto the ordinance, and suggests amendments requiring the lighting of the streets through which the lines will pass. As the company refused to give anything to the city in the first place, credit is due to Mayor Hopkins for the offer already secured.

**The Architect and Electrician.**—A contemporary says: "How frequently we notice a handsome block of offices run up, and within a few weeks or months of its completion the place is being 'pulled to pieces' for the introduction of electric communication and lighting wires. Is it cheaper to permit these inroads upon our comfort and convenience than to provide the necessary fittings during the erection of the building?" This may be the practice in the effete East or the distant West, but judging from the amount of interior conduit and metal sheathed bushings sold by one supply house alone, no modern structure is erected in Chicago without containing ample facilities for the indrawing of electric conductors.

Chicago, April 21. F. De L.

## GENERAL NOTES.

A student in a technical college recently asked for information on "edward currents."

The new electric street railway at Green Bay, Wis., will be in operation within two months.

Traction stocks have been listed in the New York Consolidated Exchange, and will be dealt in hereafter.

The new electric railroad from Savin Rock to Merwin's Point, Conn., will likely be completed by June 15. The road will cost $40,000.

Bloomington, Ill., capitalists have organized a company with a capital stock of $30,000 for the purpose of incorporating a home telephone company.

There has never been recorded a suicide with electricity as the agent. Every other known method of destroying life has been utilized by those who sought self-destruction.

The receivers of the Swampscot Machine Company have been ordered by the court to pay over to the workmen the $5,200 due them on arrears of wages, and the proceedings against the company in the probate court will be dropped.

Dr. Lucy Hall-Brown addressed the Brooklyn Woman's Club on April 9, in the assembly room of the Young Woman's Christian Association, on "Electricity in the Household." Her talk was illustrated with stereopticon views of cooking utensils and other implements used in keeping the domestic machinery in motion. After Dr. Hall-Brown's address, Professor Hopkins, of the British School of Electric Lighting and Marine Telegraphy, talked to the club about the electric motor.

## THE VAN NORMAN BENCH LATHE.

A USEFUL MACHINE TOOL FOR ELECTRO-MECHANICIANS.

The Waltham Watch Tool Company, Springfield, Mass., have recently placed upon the market the Van Norman bench lathe, illustrated herewith. In the manufacture of small tools or machinery of any description, for model making or for use in the tool room where tools are to be made and kept to accurate gauges, this lathe will be found of great value. With the large variety of attachments the lathe combines in one a hand bench lathe, screw cutting lathe, universal grinder, milling machine and gear cutter—a small machine shop in one. Although designed for the finer grades of work, the construction is such that moderately heavy work can be done with ease. This lathe is especially adapted for doing the small experimental work of electricians.

FIG. 1.—VAN NORMAN BENCH LATHE.

The plain lathe shown in Fig. 1 is adapted for all kinds of fine turning, drilling, etc. The head stock spindle and bushings are of hardened steel, and the grind spindle is hollow, and with draw-in spindle is designed for use with split chucks for holding work.

The slide rest of the lathe is very solidly and accurately made. Screws are graduated to read to thousandths of an inch. It is especially designed for use as part of the milling fixture. The method of converting the lathe into a plain milling machine is a simple one, the regular slide rest of the lathe being utilized as part of the fixture.

The index milling fixture is the same as the plain, except that an index head is attached to the top of the slide rest in place of the vise. The index head has a hollow spindle with a draw-in spindle adapted to use the regular split chucks of the lathe for holding work.

This milling fixture, complete with vise and index head, converts the lathe into a very perfect, universal milling machine, which, for small work, is greatly superior to the ordinary milling machines.

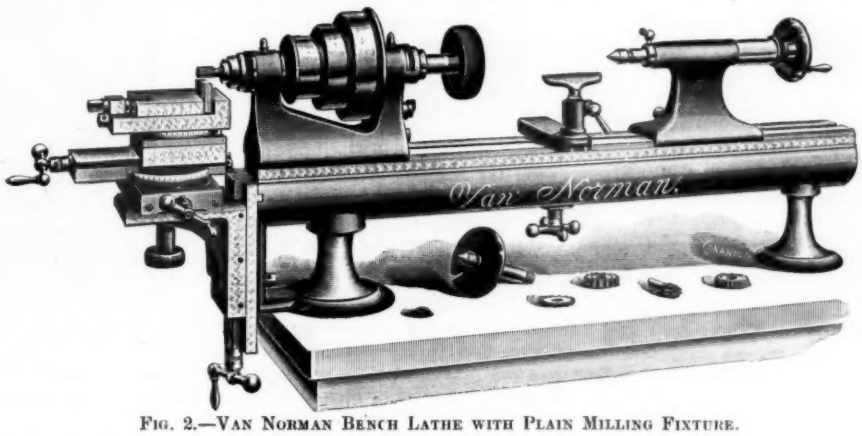


FIG. 2.—VAN NORMAN BENCH LATHE WITH PLAIN MILLING FIXTURE.

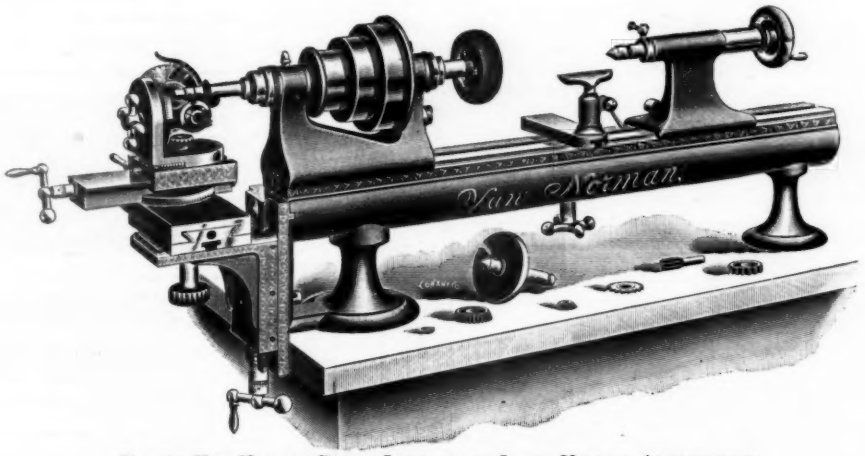


FIG. 3.—VAN NORMAN BENCH LATHE WITH INDEX MILLING ATTACHMENT.

The screw cutting attachment, with the slide rest of the lathe as part of the fixture, converts the lathe into a complete screw cutting lathe which will cut threads from 10 to 160 to the inch. A grinding attachment used with the slide rest converts the lathe into a universal grinder.

### The Quaint Club.

This peculiar organization enjoyed its beefsteak dinner at Muschenheim's, on Thirty-first street, Tuesday evening of last week. Col. John A. Cockerill presided, assisted by ex-Presidents W. J. Arkell and Geo. H Daniels—and at times all three were kept busy. Col. Geo. Gouraud, known to electrical people on both sides of the ocean, and Col. Gardiner C. Sims, of Providence, represented the electrical field as guests. James Elverson, Jr., proprietor of the Philadelphia *Inquirer*, invited the club to a planked shad dinner at Gloucester in May. The acceptance was sudden and hearty. Major J. H. Tremper, owner of several Hudson River boats and a beautiful hotel in the Catskills, invited the club to spend two days at his hotel in June. Unanimous acceptance. General Passenger Agent Charley Lambert said he would compliment the club on the West Shore up to the Tremper House and back. Great applause for Charley. W. McKloskey Rodie, of the Winnisook Indians, said his tribe would give the Catskill visitors a trout supper in their wigwam on Slide Mountain. This was promptly accepted without debate. Then Colonel Gouraud invited the club to visit his London home, offering to charter a ship of the American line. The club sang "God Save the Queen" and accepted for next year. The invitations concluded with one from Mr. Arkell asking the members to visit the famous *Judge* building on Fifth avenue any afternoon after lunch; and Wm. Berri, of the Brooklyn *Standard-Union*, told a story and everybody went home.

### Brooklyn Edison Illuminating Company.

A special meeting of the stockholders of the Edison Electric Illuminating Company, of Brooklyn, N. Y., was held last week to take action on the proposed increase of the capital stock. After a resolution increasing the stock from two and a half to three millions was passed by a vote of 21,867 out of 25,000 shares the meeting adjourned. Secretary Peabody said that substantial progress is being made by the company in getting ready its plant to light a number of the principal streets under their franchise recently given it by the city. In 20 days the company will begin to set up the poles. They will be of an ornamental style, something like those in Fifth avenue, New York. The wires will be all underground, and this will remove from the streets some 1,500 poles. By June 1 they will be ready to turn on the current.

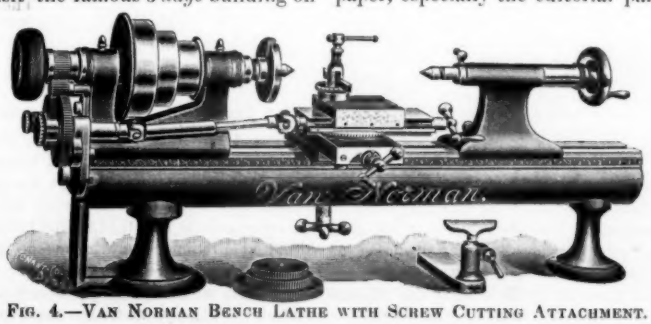


FIG. 4.—VAN NORMAN BENCH LATHE WITH SCREW CUTTING ATTACHMENT.

### CONDENSED COMPLIMENTS.

The beautiful feature to the mind of the editor is that these opinions are in every case unsolicited:

Geo. H. Howland, New York: "I like your paper very much."

C. R. Smith, superintendent Brandon, Vt., Electric Light Company: "The ELECTRICAL REVIEW is a good paper."

G. Wilbur Hubley, electrical engineer, Louisville, Ky.: "I very much appreciate your journal, which I regard as the leading and most interesting of electrical papers."

Mr. Alexander von Babo, of Chicago, representing Siemens & Halske, writes: "I have preserved your paper since I came to Chicago. I like to say I enjoy reading your paper, especially the editorial part of it and those little spirited notes about happenings during the week, which seem to characterize the ELECTRICAL REVIEW."

## KINDRED INTERESTS

**The Holtzer-Cabot Electric Company,** Boston, has declared a dividend of two per cent.

**The Bradford Self-Closing Telegraph Key Company,** of Clinton, Me., has received an inquiry from the Russian government regarding the cost of 1,600 keys.

**The Day-Moberg Electric Company,** 54 Pearl street, Boston, Mass., has issued a very interesting pamphlet about the Jupiter storage battery. Considerable information on storage batteries in general is given.

**The Brush Electric Company,** Cleveland, O., was successful in securing the order for 1,500 arc lamps from the city of Detroit, Mich., for the new municipal plant. The fight was a lively one, and the Brush company is to be congratulated on securing such a large order.

**The Buckeye Electric Company,** Cleveland, O., has sent out a tasteful little pamphlet executed in colors giving descriptions and illustrations of the standard Buckeye loop filament, railway and Buckeye special lamps. The pamphlet also contains a code of cipher words to be used in ordering Buckeye lamps by telegraph.

**Dr. Drysdale,** of Philadelphia, has placed the contract for an iron roof over the new power house for the Hospital for the Insane at Norristown, Pa., with the Berlin Iron Bridge Company, of East Berlin, Conn. It was desired that the roof be fire-proof, and ordinary corrugated iron could not be used on account of the drip, so that the roof will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron covering.

**The Berlin Iron Bridge Company,** of East Berlin, Conn., are doing considerable iron bridge work at the present time. Among other contracts they have 17 signal bridges for the Boston and Maine railroad, two bridges 200 feet long for the town of Roxbury, Conn., a bridge 400 feet long across the Connecticut River at Stratford, N. H., a bridge 350 feet long at Turner, Me., a bridge 200 feet long at Houlton, Me., and a bridge 200 feet long at Moosup, Conn.

**The Mather Electric Company,** Manchester, Conn., report the following sales of apparatus outside of their railway business for the last 10 days:

Massachusetts Hospital for the Insane, Northampton, Mass., one 350 light and one 600 light dynamo; Eastern Yacht Club, Boston, Mass., one 250 light dynamo; Wayne County House, Wayne, Mich., two 20 kilowatt direct-connected dynamos; E. N. Blake, Elmira, N. Y., one 350 light dynamo; Sherman and Koof, Detroit, Mich., one 250 light dynamo; George Whitney Woollen Company, South Royalston, Mass., one 100 light dynamo; Syracuse *Herald*, Syracuse, N. Y., one 250 light dynamo; Union Central Life Insurance Building, Buffalo, N. Y., one 450 light dynamo and one 250 light dynamo; Patent Cereal Company, Geneva, N. Y., one 150 light dynamo; Crane Brothers, Westfield, Mass., one 50 light dynamo; Henry Reinhardt, New York city, one 150 light dynamo; Boston Ferrule Company, East Boston, Mass., one 50 horse-power slow-speed motor; Phelps Publishing Company, Springfield, Mass., one 50 horse-power slow-speed motor; also in Springfield two 15 horse-power and one 1 horse-power motors. Sixteen other motors from 1 to 15 horse-power in various places.

**Laying a Kerite Cable.**—Too little is known by the users of telephones of the vast amount of labor and capital expended to render to the consumer an efficient telephone service. Ordinarily the subscriber is apt to look at the visible telephone in his office as a unique piece of furniture without giving much thought as to what was involved in putting it there. A representative of the ELECTRICAL REVIEW was a guest of the New York and New Jersey Telephone Company at a recent cable laying expedition. The twin screw steamer "Western Union" left the Barge Office at the Battery and proceeded down the bay to Staten Island, through the Kills and up Newark Bay to the Passaic River. The day was delightful, and the sail, under the supervision of Mr. T. A. Stevens, of the New York and New Jersey company, was most enjoyable. One thousand two hundred feet of 10 pair submarine Kerite cable was laid in the Passaic River, and 2,100 feet 10 pair submarine Kerite cable at the Hackensack River. These lines form part of a trunk line to Newark. The "Western Union" then steamed to the Raritan Bay and cleverly deposited 3,700 feet of seven pair submarine Kerite cable, which will form part of a trunk line to Long Branch. This work was found necessary to keep up with the rapidly increasing business of this section of the telephone company's lines.

### The Queen-Le Chatelier Pyrometer.

Modern investigation and many of our modern industries demand an instrument for the accurate measurement of very high temperatures. A vast amount of experimental work in this line has been done by physicists and metallurgists in the past, their most noteworthy results having been achieved by the employment of the air or gas thermometer, which depends for its action upon the expansion of air instead of mercury, as in the ordinary forms of thermometers. The bulbs of these thermometers they constructed of materials like glass or platinum, whose melting points are very high. In the more recent experiments, however, porcelain bulbs were used.

These air thermometers are not very convenient or practical instruments, requiring, as they do, a great deal of subsidiary apparatus and the application of many corrections to the readings. With them, however, eminent scientists have done us invaluable service by establishing many fixed temperatures, such as the melting points of various metals. These may safely be relied upon in graduating other forms of pyrometers. M. Le Chatelier in constructing his pyrometer has made use of these known melting points.

It is based upon the principle of measuring the electric current generated by the heating of a thermo electric junction. As modified by Queen & Company, it consists of a thermo-electric couple and a D'Arsonval galvanometer. The wires which compose the couple are one of pure platinum and the other platinum alloyed with 10 per cent. rhodium, both of which are perfectly homogeneous. For use, the couple, which has been first connected with the galvanometer, is inserted into the furnace or oven, when immediately a current is produced and measured on the galvanometer scale, from which the temperature is readily deduced. The pyrometer has the following advantages claimed for it:

1. It is adapted for a very large range of temperature, *i. e.*, from 200 degrees to 3,000 degrees Fahrenheit, but is intended more especially for high temperatures, such as are met with in the manufacture of metals, chemicals, porcelain ware, etc.

2. It is almost instantaneous in its indications, five seconds being sufficient time to subject the couple to any stationary temperature; or the couple may, if desired, be left permanently in the furnace or oven, indicating at all times the temperature, and thus enabling the operator to keep an hourly record of it.

3. The metals which compose the couple are not affected by gases and hence will not become oxidized or react chemically on each other at high temperatures; nor are they altered in their thermo-electric properties by rough usage or bonds.

The measurement of the temperature is made by means of a D'Arsonval galvanometer, contained in two wooden boxes, which are screwed against a central wall or slab with handle for portability, as shown in Fig. 1. Fig. 2 shows the two boxes unscrewed from the central slab and placed in their respective positions against the wall.

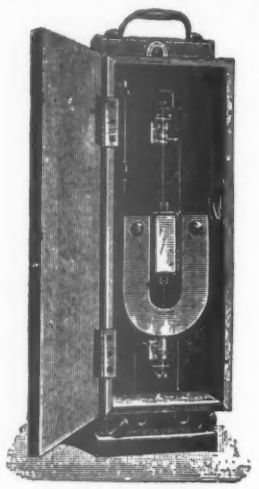

FIG. 1.—D'ARSONVAL GALVANOMETER, QUEEN-LE CHATELIER PYROMETER.

Box A contains the galvanometer proper and is also provided with set screws and a small plumb bob, so that it may be set vertically. Box B contains the lamp, having a lens and window with cross hairs for throwing an image upon the galvanometer mirror in box A, which in turn reflects it back upon the scale in box B. Box B has also two set screws for adjusting it vertically. The two boxes are set one metre apart.

The current set up by the thermo-electric couple (no battery is used) enters the galvanometer through the two binding posts, Box A, and the deflection caused by it is shown upon the scale, Box B. This scale is graduated in millimeters and it is necessary, therefore, that a curve be made reducing these millimeters to degrees Fahrenheit or Centigrade. This curve is very simply made from known melting points given herewith: Water boils, 212 degrees Fahrenheit; lead melts, 617 degrees Fahrenheit; zinc melts, 779 degrees Fahrenheit; gold melts, 1,913 degrees Fahrenheit; palladium melts, 2,732 degrees Fahrenheit. This instrument is fully described in a pamphlet of pyrometers, published by Queen & Company, Incorporated, of Philadelphia.

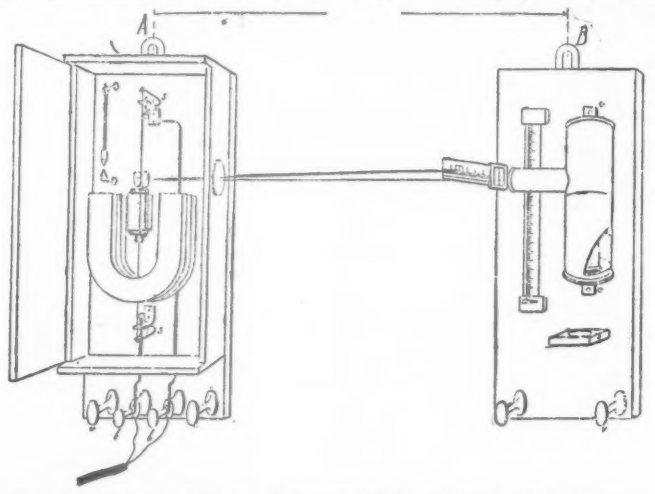


FIG. 2.—GALVANOMETER AND LAMP, QUEEN-LE CHATELIER PYROMETER.


## PROPOSALS FOR LIGHTING.

SEALED PROPOSALS for lighting the streets of the City of Williamsport, Pa., for a period of five years from Dec. 1, 1894, with electricity, gas, or otherwise, will be received at the office of the city clerk up to 12 M. of Monday, April 30, 1894. Bidders will state plainly the kind of lights, number, location and candle-power of the same. Said lighting is to be for every night in the year from dark to daylight. Each bid must be accompanied by a certified check for one thousand dollars. The city reserves the right to reject any or all bids.

WILLIAM DREISBACH,
City Clerk.

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